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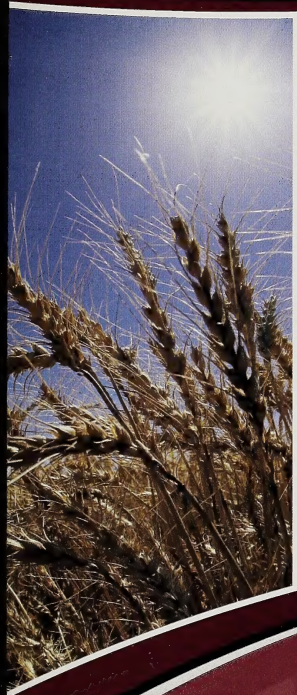

Module 4
MAPS, DATA, and PROBABILITY

Learning Technologies Branch

Alberta LEARNING

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MATHEMATICS 24

Module 4
MAPS, DATA, and PROBABILITY

Mathematics 24
Module 4: Maps, Data, and Probability
Student Module Booklet
Learning Technologies Branch
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This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

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- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

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Welcome to MATHEMATICS 24

Module Four

Mathematics 24 contains six modules. You should work through the modules in order (from 1 to 6) because concepts and skills introduced in one module will be reinforced, extended, and applied in later modules.

Module 1
INDEPENDENT LIVING

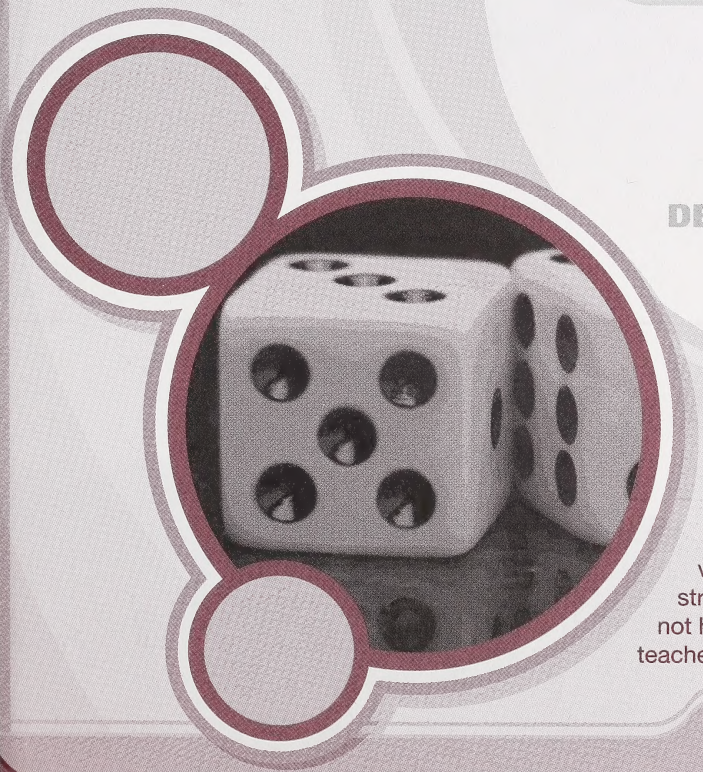
Module 2
WHEELS

Module 3
APPLYING GEOMETRY

Module 4
MAPS, DATA, and PROBABILITY

Module 5
STATISTICS

Module 6
DESIGN and CONSTRUCTION



Module 1 contains general information about the course components, required resources, visual cues, assessment and feedback, and strategies for completing your work. If you do not have access to Module 1, contact your teacher to obtain this important information.

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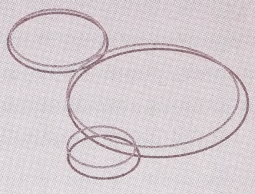

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MODULE OVERVIEW

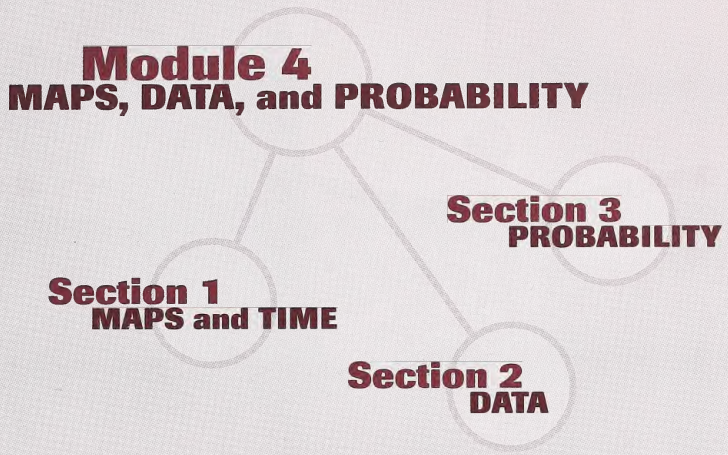
Have you ever gone hiking in the wilderness? You would probably find a map of the area useful. Like the hiker in the photo, finding your way is a lot easier when you have a good idea of where you are and how to get to your destination. It also helps if you know where the trouble spots are.

These are things a good map can provide for you. It will show you the hills and streams. It will show you the distances between places. It will even show you where there are cliffs and other places that may be difficult to navigate. You might have to look around for a little bit more data to be sure where you are, but a map gives a lot of information.

Knowing the time of day can also help. Not only does the time let you know how long until dark, it also can give you an idea of direction so you can orient yourself on the map. For example, when your watch tells you it's noon, your shadow points northward. One way to use your watch to find directions can be found at the following website:

http://www.i4at.org/surv/directon.htm

In this module you will look at maps, different ways to express time, how time zones work, how you can present and use data, and how chance and probability are used.



Your mark on this module will be determined by how well you complete the two Assignment Booklets.

The suggested mark distribution is as follows. Be sure to check with your teacher if this mark allocation is valid for you. Some teachers like to include other reviews and assignments.

Assignment Booklet 4A

Section 1 Assignment	18 marks
Section 2 Assignment	17 marks

Assignment Booklet 4B

Section 3 Assignment	30 marks
Final Module Assignment	35 marks
Total	100 marks

When doing the assignments, work slowly and carefully. Be sure you attempt each part of the assignments. If you are having difficulty, you may use your course materials to help you, but you must do the assignments by yourself.

You will submit Assignment Booklet 4A to your teacher before you begin Section 3. You will submit Assignment Booklet 4B to your teacher at the end of this module.

SECTION 1

Maps and Time

Taking a planeload of passengers or cargo across the ocean is a large responsibility. The flight crew has to know where it is and where it is going all the time. In modern large aircraft, instruments tell the flight crew everything it needs to know.

Have you ever wondered how planes reached their destinations before inventions like GPS (global positioning system) and radar? Pilots and navigators used maps and clocks and information about airspeed to find their location.

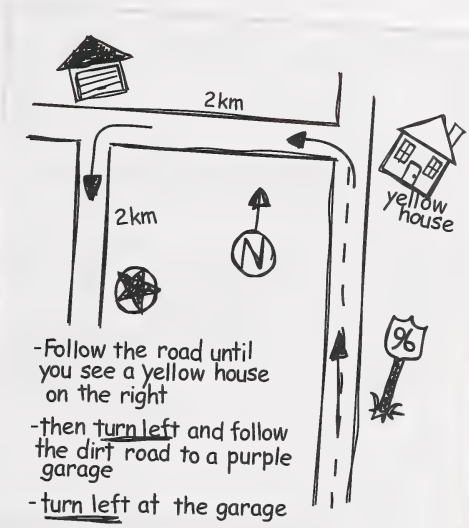
In this section you will learn more about maps and time. You will learn how to find distances by looking at maps. You will also learn how to find out what time it is in other parts of the world.

LESSON 1

Distances on a Map

In this lesson you will find distances between locations using maps and map scales.

Have you ever been in a strange place and needed help finding your way? Would having directions like the ones shown to the right make you more comfortable?


2km
2km
N
yellow house
-Follow the road until you see a yellow house on the right
-then turn left and follow the dirt road to a purple garage
-turn left at the garage

Maps may not have descriptions of the colours of houses and garages, but they do contain the information you need to help you find your destination.

Maps are useful in other ways too. You can use them to see where other places are, and you can use them to see how far away places are.

Right now you will see how the scale on a map is used to find distances from a map.

Turn to page 198 in your textbook and read the "get thinking" box at the top of the page. With these questions in mind, read the first paragraph of "Tutorial One: Distances on a Map."

1. Continue on pages 198 and 199 in your textbook. Complete questions 1 to 3 of "Investigation 1: How can you determine distance on a map using a simple scale?"

Check your answers on pages 49 and 50 in the Appendix.

Example

Convert 2 000 000 cm to a distance in kilometres.

First, remember that 1 m is 100 cm.

$$2\,000\,000\text{ cm} = \frac{2\,000\,000\ \cancel{\text{cm}}}{1} \times \frac{1\text{ m}}{100\ \cancel{\text{cm}}}$$

$$= \frac{\overset{20\,000}{\cancel{2\,000\,000}}\text{ m}}{\underset{1}{\cancel{100}}}$$

$$= 20\,000\text{ m}$$

Notice that the units can be treated like factors. It lets you see the change in units taking place.

Then remember that 1 km is 1000 m.

$$20\,000\text{ m} = \frac{20\,000\ \cancel{\text{m}}}{1} \times \frac{1\text{ km}}{1000\ \cancel{\text{m}}}$$

$$= \frac{\overset{20}{\cancel{20\,000}}\text{ km}}{\underset{1}{\cancel{1000}}}$$

$$= 20\text{ km}$$

Again, notice that the units can be treated like factors.

Example

Convert 5 km to a distance in centimetres.

Remember, there are 1000 m in 1 km and 100 cm in 1 m. You can write conversions in one long step rather than the two steps used in the preceding example.

$$5\text{ km} = \frac{5\ \cancel{\text{km}}}{1} \times \frac{1000\ \cancel{\text{m}}}{1\ \cancel{\text{km}}} \times \frac{100\text{ cm}}{1\ \cancel{\text{m}}}$$

$$= \frac{500\,000\text{ cm}}{1}$$

$$= 500\,000\text{ cm}$$

Notice again that the units can be treated like factors.

Example

The **scale** on a map is given as 1:250 000. The distance between two towns, Ponteix and Kincaid, is 16 cm on the map. How far apart are these towns?

Remember that on the map scale, the first number (in this case 1) refers to the distance on the map. The second number (in this case 250 000) refers to the actual distance.

Let the actual distance between the two towns be x. Set up a **proportion** to find the actual distance.

$$\frac{1}{250\,000} = \frac{16\text{ cm}}{x}$$

$$1 \times x = 250\,000 \times 16\text{ cm}$$

$$x = 4\,000\,000\text{ cm}$$

$$x = 4\,000\,000\ \cancel{\text{cm}} \times \frac{1\ \cancel{\text{m}}}{100\ \cancel{\text{cm}}} \times \frac{1\text{ km}}{1000\ \cancel{\text{m}}}$$

$$x = \frac{4\,000\,000\text{ km}}{100\,000}$$

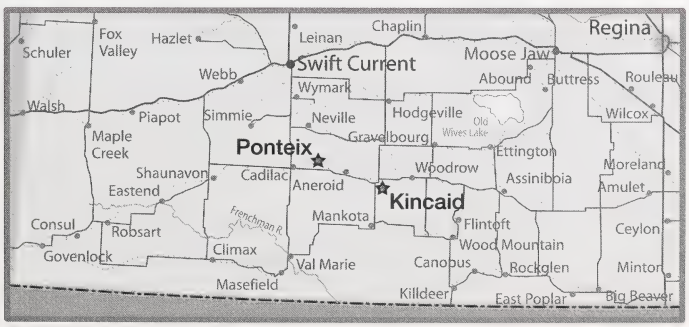
$$x = 40\text{ km}$$

This proportion is most easily solved by cross-multiplying.

Convert the centimetres to kilometres. Notice again that the units can be treated like factors.

2. Turn to pages 200 and 201 in your textbook. Complete questions 1.a. to 1.f. of "Investigation 2: How can you determine distance using a **ratio** scale?"

Check your answers on pages 50 and 51 in the Appendix.



Example

Using the distance table below, find the distance from Red Deer to Medicine Hat.

Find the first location in the first column. The required answer is in the same row as this name. In the table shown here, the row is coloured.

Now find the second location along the top row. The required answer is in this column. In the table shown here, this column is coloured.

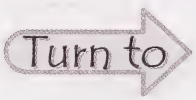
The answer lies where the coloured row and the coloured column meet.

	Calgary	Edmonton	Lethbridge	Red Deer	Medicine Hat
Calgary		290	175	145	260
Edmonton	290		435	145	435
Lethbridge	175	435		300	160
Red Deer	145	145	300		335
Medicine Hat	260	435	160	335	

The distance from Red Deer to Medicine Hat is 335 km.

3. Turn to pages 201 to 203 in your textbook. Complete questions 2.b., 4.a., 6.a., 7.b., and 8.b. of "Put into Practice." (**Note:** Use the distance tables on pages 389 and 390 in the textbook to answers questions 7.b. and 8.a.)

Check your answers on pages 51 to 53 in the Appendix.

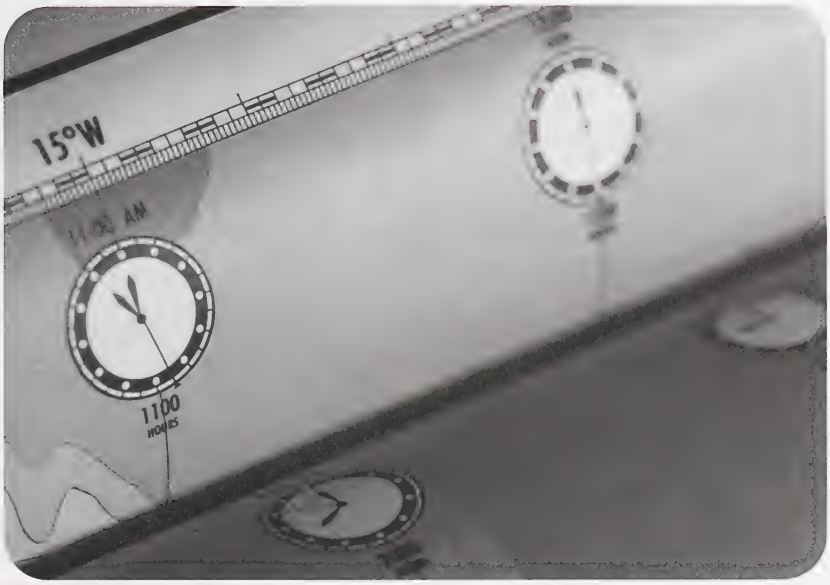


the Section 1 Assignment in Assignment Booklet 4A. Answer question 1.

LESSON 2

Time

In this lesson you will see how the time is different in other parts of the country.



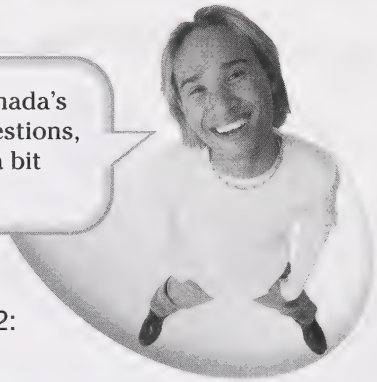
The clocks on the map above show that it isn't the same time everywhere. In fact, they show much more than that. It looks like the times are pretty much the same except for the hour. Why is that?

Before 1883, communities in Canada set their own time. For example, clocks in Medicine Hat would have been set to a different time than clocks in Calgary. Communities usually used "sun time" to determine their time—12:00 noon was when the sun was highest in the sky and shadows pointed directly north.

Now it's a lot simpler to know what time it is because large areas share a common time. Things may be simpler, but there are still ways that time can be confusing. Hopefully this lesson will clear up some of the confusion.

1. Turn to pages 204 and 205 in your textbook. Complete questions 1 to 4 of "Investigation 1: 12 and **24 Hour Time**."

Check your answers on pages 53 and 54 in the Appendix.



In the next investigation, you will see how Canada's **time zones** work. As you work through the questions, try to see which time zones in Canada are a bit different than the rest.

2. Turn to pages 206 and 207 in your textbook. Complete questions 1 to 5 of "Investigation 2: Time Zones."

Check your answers on pages 54 and 55 in the Appendix.

Did you notice that the time zones for Saskatchewan and Newfoundland and Labrador work differently than the time zones for the other provinces and territories? Saskatchewan doesn't use **daylight-saving time**. Newfoundland and Labrador has a time zone that is a half hour different than its neighbours. All the other time zones have one-hour differences.

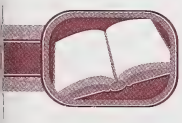
Example

The times in several places in Canada are shown in the table on the next page. For each of them, find the equivalent time in Red Deer, Alberta.

Look at the following list if you need help with any of the acronyms for the time zones.

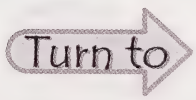
ADT – Atlantic Daylight Time
AST – Atlantic Standard Time
CDT – Central Daylight Time
CST – Central Standard Time
EDT – Eastern Daylight Time
EST – Eastern Standard Time
MDT – Mountain Daylight Time
MST – Mountain Standard Time
NDT – Newfoundland Daylight Time
NST – Newfoundland Standard Time
PDT – Pacific Daylight Time
PST – Pacific Standard Time
UTC – Co-ordinated Universal Time

Time and Place	Time in Red Deer, Alberta
July 10, 16:45 h Corner Brook, Newfoundland (NDT)	16:45 – 00:30 = 16:15 (ADT) 16:15 – 01:00 = 15:15 (EDT) 15:15 – 01:00 = 14:15 (CDT) 14:15 – 01:00 = 13:15 (MDT) It will be 13:15 h in Red Deer.
August 15, 07:05 h Regina, Saskatchewan (CST)	Daylight-saving time is in effect in Alberta, but not in Saskatchewan; therefore, there is no difference in time. It will be 07:05 h in Red Deer.
September 17, 1:28 p.m. Shelburne, Nova Scotia (ADT)	1:28 p.m. – 01:00 = 12:28 p.m. (EDT) 12:28 p.m. – 01:00 = 11:28 a.m. (CDT) 11:28 a.m. – 01:00 = 10:28 a.m. (MDT) It will be 10:28 a.m. in Red Deer.
November 3, 1:19 a.m. Chibougamau, Quebec (EST)	1:19 a.m. – 01:00 = 12:19 a.m. (CST) 12:19 a.m. – 01:00 = 11:19 p.m. (MST) It will be 11:19 p.m. in Red Deer.
December 10, 04:17 h Victoria, British Columbia (PST)	04:17 + 01:00 = 05:17 (MST) It will be 05:17 h in Red Deer.
December 27, 13:15 h Divide, Saskatchewan (CST)	Daylight-saving time is not in effect. 13:15 – 01:00 = 12:15 (MST) It will be 12:15 in Red Deer.
January 15, 22:20 h Seal Cove, Newfoundland (NST)	22:20 – 00:30 = 21:50 (AST) 21:50 – 01:00 = 20:50 (EST) 20:50 – 01:00 = 19:50 (CST) 19:50 – 01:00 = 18:50 (MST) It will be 18:50 h in Red Deer.



3. Turn to page 208 in your textbook. Complete questions 1 to 5 of "Put into Practice."

Check your answers on page 56 in the Appendix.



the Section 1 Assignment in Assignment Booklet 4A.
Answer question 2.

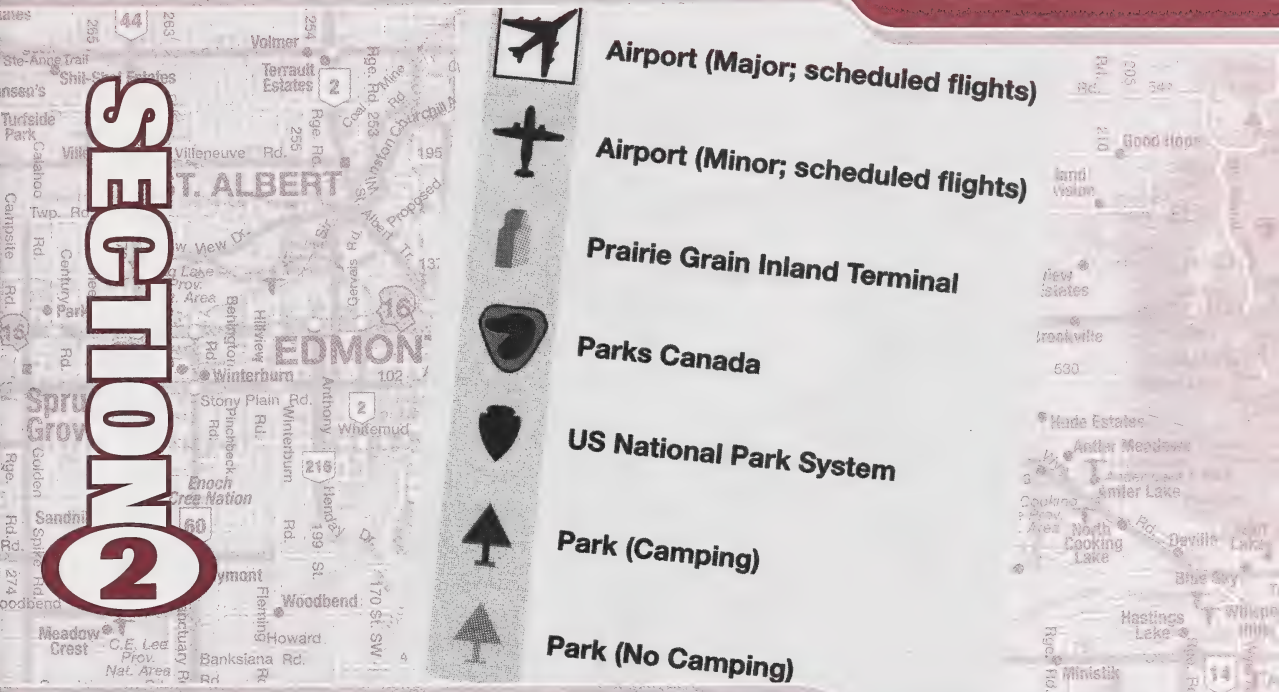
CONCLUSION

In this section you studied the use of maps and time. You found the actual distance between places using the distances on a map and the map scale, used the 24-hour clock, and saw that times in different parts of Canada are different.

These same skills are used in many professions. Pilots and navigators in modern planes have a lot of instruments to help them, but they still have to keep track of where they are and how long they have been flying.

If you have access to the Internet, visit the following websites to find out just how important it is to be able to convert units and navigate correctly.

- **http://archives.cbc.ca/IDC-1-69-240-1155-20/that_was_then/life_society/gimli_glider**
- **http://www.casa.gov.au/avreg/fsa/03jul/22-27.pdf**



SECTION 2

Data

Some maps have a lot of information and detail packed into them, particularly provincial and territorial road maps. The more detailed a map is, the more likely it is to have a legend to explain what all the different symbols used on the map mean.

Look at the map legend shown above. It describes a lot of map symbols. The way the symbols and descriptions are arranged in the legend is quite interesting. It manages to pack a lot of information into a relatively small space. This is one important feature of data tables.

In this section you will look at different ways to display data in tables and graphs. Graphs can be used to observe trends and make predictions, but they can also be used to misinform. You'll learn more about this later.

LESSON 1

Reading, Displaying, and Interpreting Statistics

In this lesson you will learn about making and reading graphs and understanding what graphs show.

A picture is worth a thousand words. This is particularly true with statistical or numerical data. If data can be turned into a picture, it's usually much easier to understand. A complex amount of information can be displayed in a simple graph.

You are going to turn data into graphs. You will also be "reading" graphs to interpret the information they contain.

Turn to page 209 in your textbook. Read the questions in the "get thinking" box at the top of the page to get thinking about graphs.

1. Turn to pages 209 and 210 in your textbook. Complete questions 1 and 2.a. of "Investigation: Displaying Data."

Check your answers on pages 56 and 57 in the Appendix.

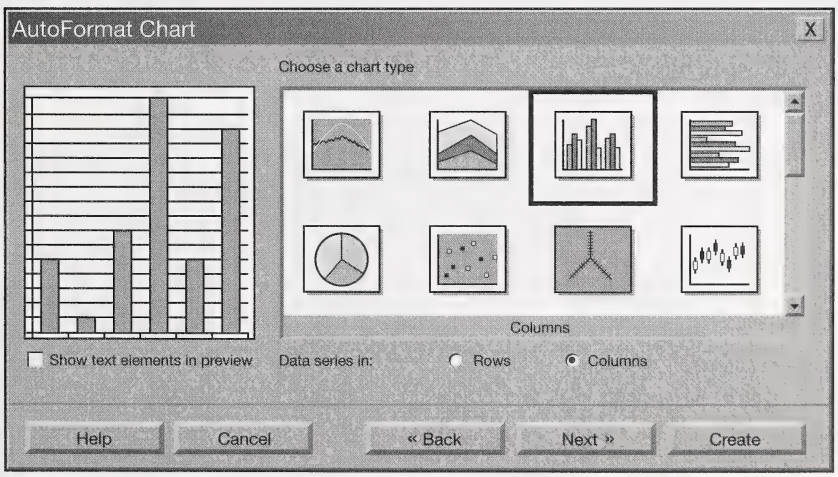
Turn to page 211 and study Example 1. It shows two different ways to graph the same information.

Example

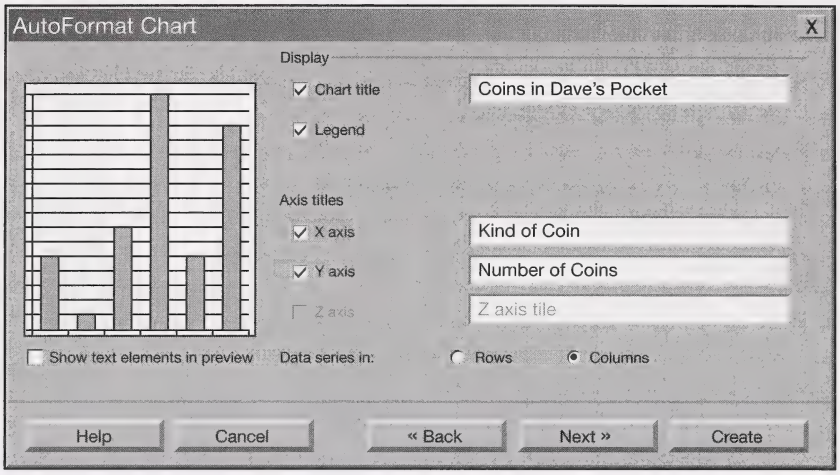
After a day at the fair, there were 5 toonies, 1 loonie, 7 quarters, 5 nickels, 15 dimes, and 13 pennies in Dave's pocket. Use a spreadsheet program to create a **bar graph** of the number of coins left in Dave's pocket.

This solution uses the free OpenOffice.org 1.1 spreadsheet program. You can use any spreadsheet program that supports drawing bar graphs.

- Enter the types of coins in column A.
- Enter the number of each type of coin in column B.
- Select all of the occupied cells.
- From the Insert menu, choose Chart. Click on the Next button.
- Click on the bar graph in the right pane of the window. Click the Next button twice.

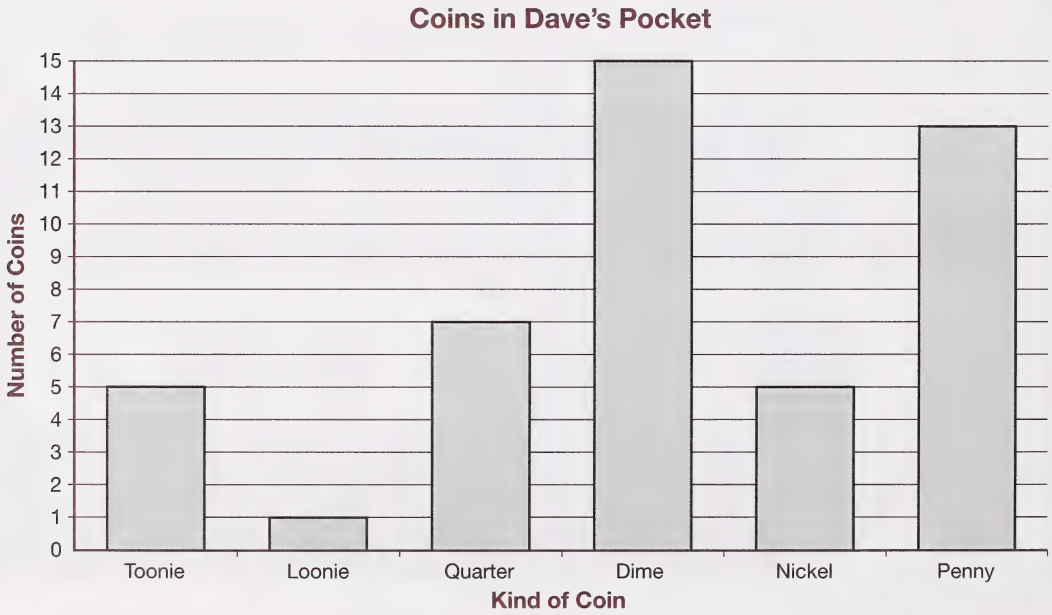


- Add a title for the graph and a title for the *x*-axis and the *y*-axis. You may have to check the little boxes under Axis titles to be able to enter the last two titles.



- Click the Create button.

You should get a bar graph that looks similar to the one that follows.



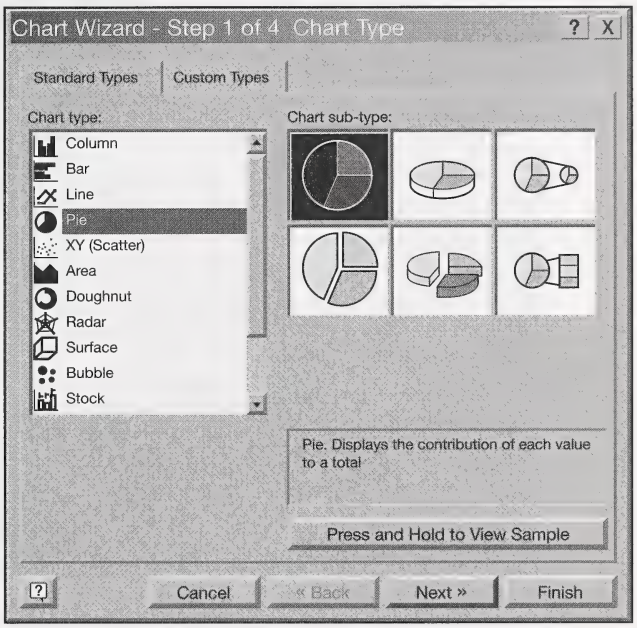
Turn to pages 212 to 214 in your textbook. Work through Examples 2 and 3. These examples show the two sides of graphs. One side is getting and using information from the data in the graph. The other side is creating the graph from data.

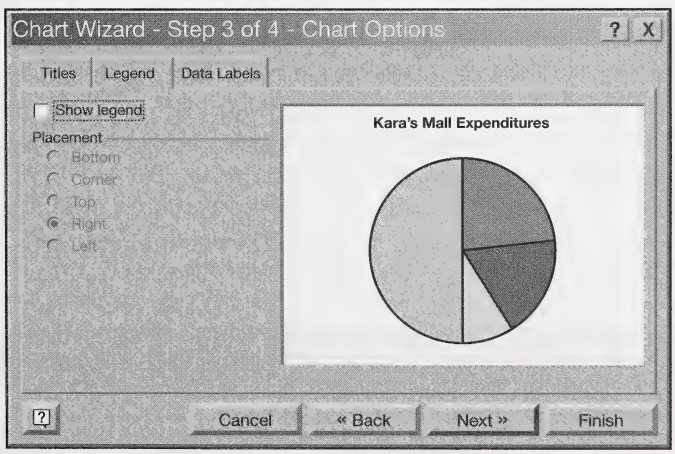
Example

Kara spent $32.00 on CDs, $24.00 at a movie, $12.00 on lunch, and $68.00 on jeans. Use a spreadsheet program to create a **circle graph** or **pie chart** from the data about how much money Kara spent.

This solution uses Microsoft Excel. You can use any spreadsheet program that supports drawing circle graphs.

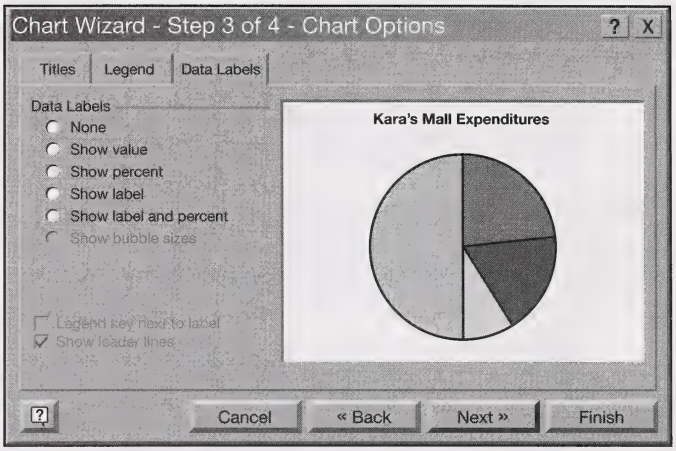
- Enter the types of expenditures in column A.
- Enter the value of each expenditure in column B.
- Select all of the occupied cells.
- From the Insert menu, choose Chart. Choose Pie from the Chart type pane. Click the Next button twice.



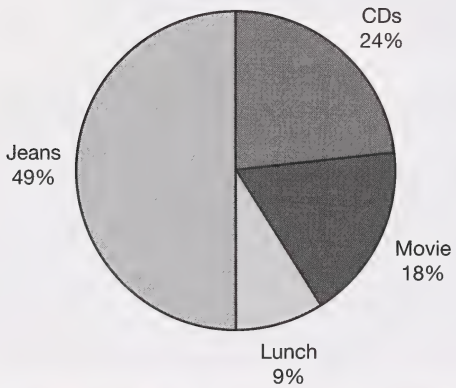


- Enter the title of the graph.
- Click the Legend tab and remove the check mark beside Show legend.

- Click on the Data Labels tab and change the selection from None to Show label and percent.
- Click the Finish button.



Kara's Mall Expenditures



You should get a pie graph that is similar to the one at the left.

Turn to pages 214 and 215 in your textbook. Work through Examples 4 and 5. These examples deal with **broken-line graphs**. You can create this kind of graph from your spreadsheet program.

2. Turn to pages 216 to 219 in your textbook. Complete questions 1, 3, 4, 5, 8.a., 8.b., and 8.c. of "Put into Practice."

Check your answers on pages 57 to 59 in the Appendix.

Turn to the Section 2 Assignment in Assignment Booklet 4A. Answer question 1.

LESSON 2

Trends and Predictions

In this lesson you will use graphs to make predictions from data.

When businesses create their plans for the next few months, what methods do they use to predict how business will fare in the future? They make predictions based on what has happened in the past. They look for **trends** that will continue and that they can use to predict the future.

Turn to page 220 in your textbook. Read the "get thinking" box at the top of the page. Two important words, **interpolation** and **extrapolation**, are explained in the note on the left side of the page. Now read the rest of page 220.

Turn to pages 221 and 222 in your textbook. Work through "Example 1: Making Predictions Using a Broken Line Graph." Pay close attention to how interpolation and extrapolation are used.

Data that is collected often does not lend itself to a broken-line graph; however, it is still possible to use graphing techniques to see trends. Turn to page 223 in your textbook. Work through "Investigation: Line of Best Fit" to see how to make a **line of best fit** by hand. Then turn to page 225 in your textbook and work through "Example 2: Making Predictions Using a 'Line of Best Fit.'"

Example

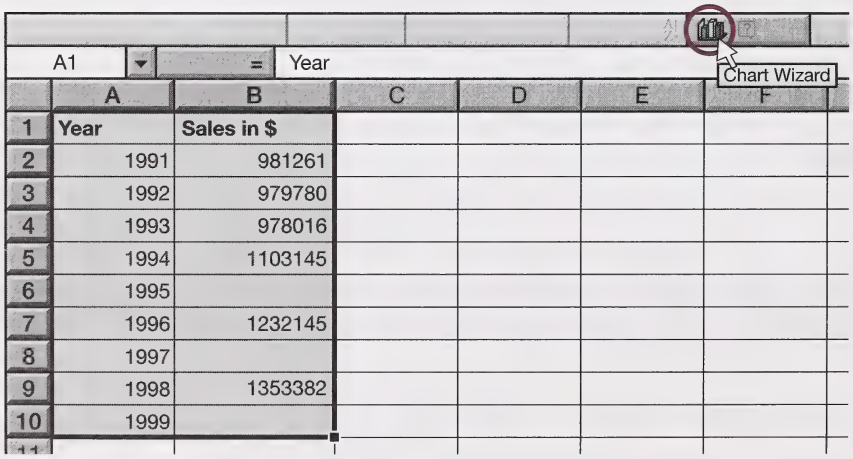
Use a spreadsheet program to graph the data from "Example 2: Making Predictions Using a 'Line of Best Fit.'" Use the **trendline** capabilities of the spreadsheet program to draw a line of best fit.

Following are the instructions to get such a graph and trendline using Microsoft Excel:

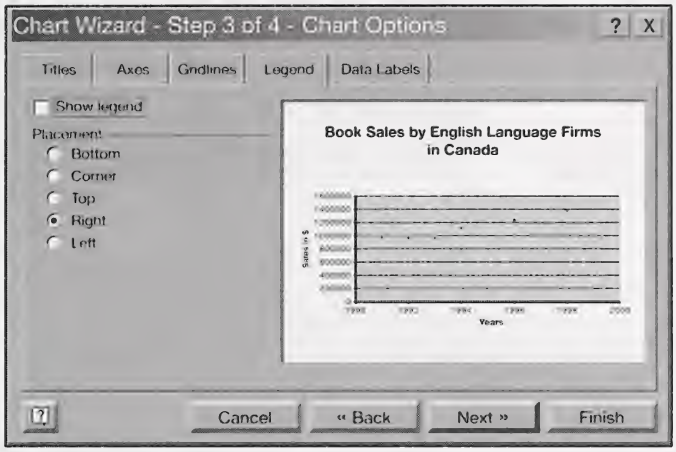
- Start by entering the data into columns A and B. Include the years that you want to interpolate for and extrapolate to.

	A	B
1	**Year**	**Sales in $**
2	1991	981261
3	1992	979780
4	1993	978016
5	1994	1103145
6	1995	
7	1996	1232145
8	1997	
9	1998	1353382
10	1999	

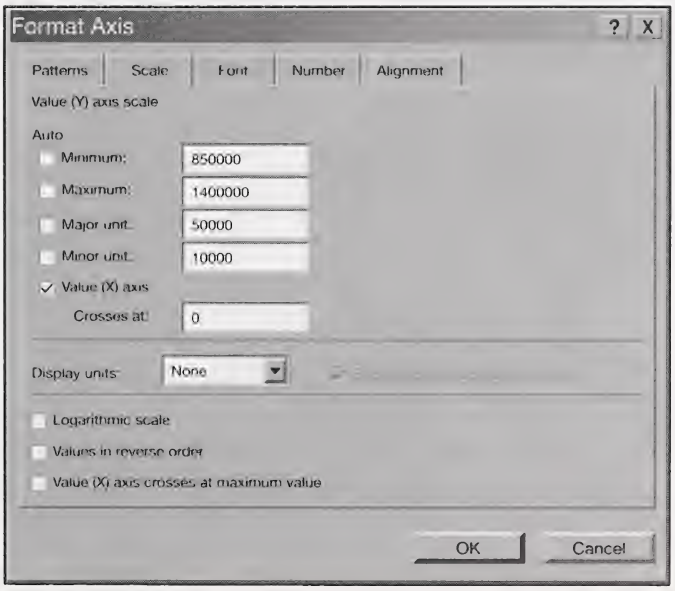
- Select the data you entered and then click on the Chart Wizard button on the tool bar.



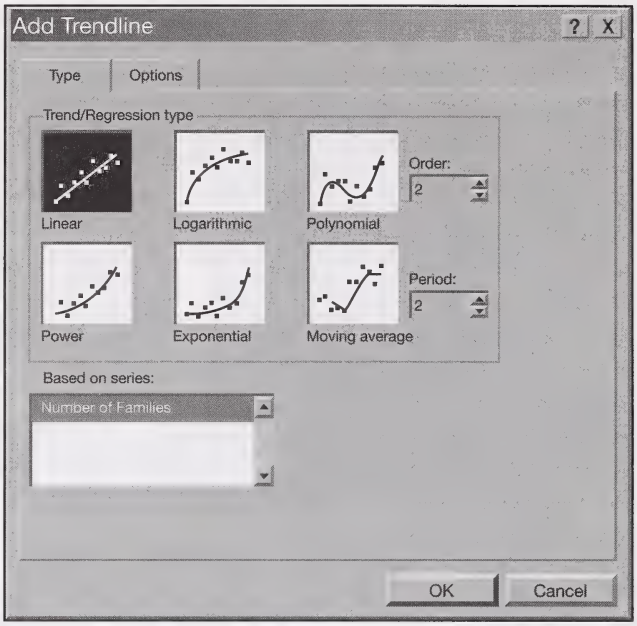
- Choose XY (Scatter) and then click the Next button twice.
- Add the titles under the Titles tab and remove the legend under the Legend tab, then click the Next button and then the Finish button.



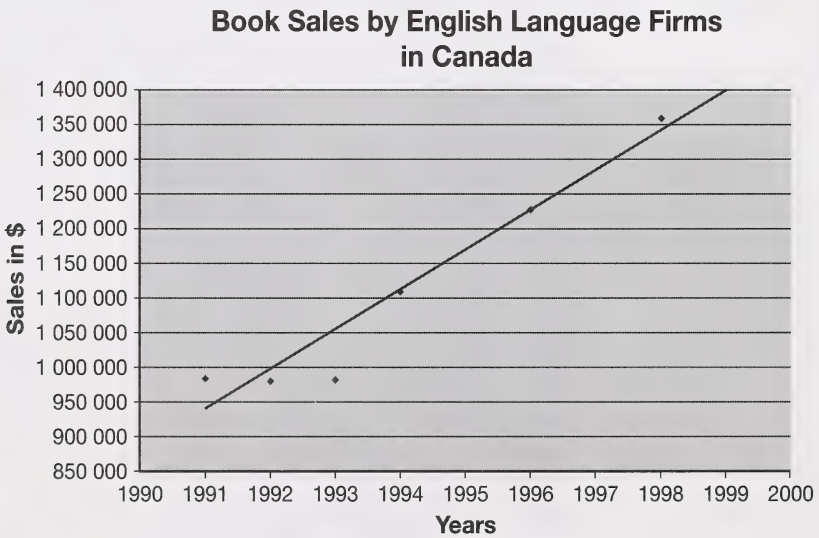
- Because the graph has a large starting value for Sales, predictions are harder to make. To change the *y*-axis scale, right click on the value 200000 and then click on Format Axis. Make the settings match those shown below. Then click the OK button.



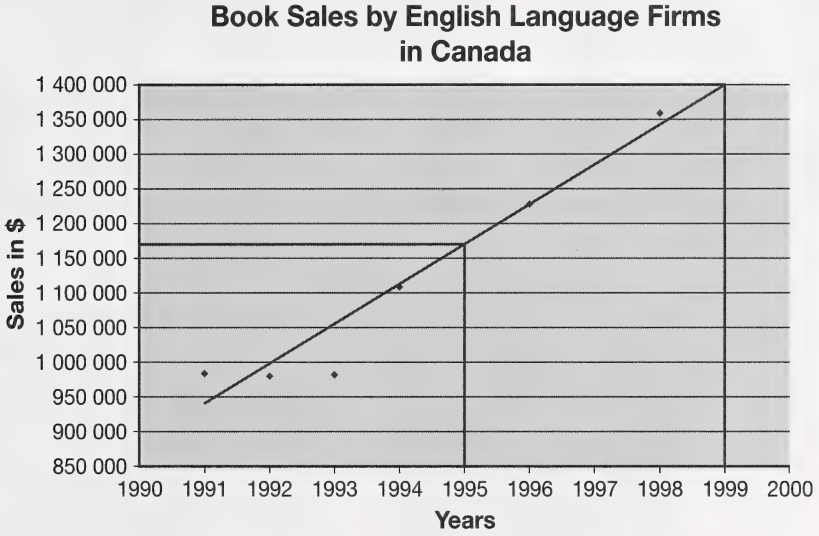
- Right click on one of the data points on the graph and choose Add Trendline. Choose the Linear type and then click on the OK button.



You will get a graph much like the one that follows. Use the line of best fit to find approximate values for 1995–96 and 1999–2000.



You can use the line of best fit to help interpolate between given values. You can also use it to extrapolate beyond the given values. This is shown on the following graph.



To find a value for the 1995–1996 year, move straight up from 1995 on the *x*-axis until you meet the line of best fit. Then move straight across the graph to the value of sales. To find a value for 1999–2000, use a similar method. Move up from 1999 until you meet the line of best fit. Then move straight to the left to find the value of sales.

The estimated value for 1995–1996 would be $1 170 000. The estimated value for 1999–2000 would be $1 400 000. (The same values were obtained on page 225 in the textbook.)

There is a danger in using interpolation and extrapolation. The values will be reasonably correct only if the line you use fits the actual data closely.

Turn to pages 226 to 229 in your textbook. Complete questions 1 to 5 of "Put into Practice."

Check your answers on pages 59 to 66 in the Appendix.

Turn to the Section 2 Assignment in Assignment Booklet 4A. Answer question 2.

LESSON 3

Fair and Accurate Presentation of Data

In this lesson you will learn how to ensure graphs are not used to mislead you. You will also create graphs that fairly and accurately represent data.

If you were going to get the kind of reaction shown in the picture, you might look for a way to prevent it. Perhaps you could make the graph so it isn't so obvious that there is a problem.

There are a number of different ways to manipulate the results of graphing data.

Turn to page 230 in your textbook. Read the "get thinking" box at the top of the page.

1. Turn to pages 230 to 232 in your textbook. Complete questions 1 and 2 of "Investigation 1: Looking at Graphs."

Check your answers on page 67 in the Appendix.

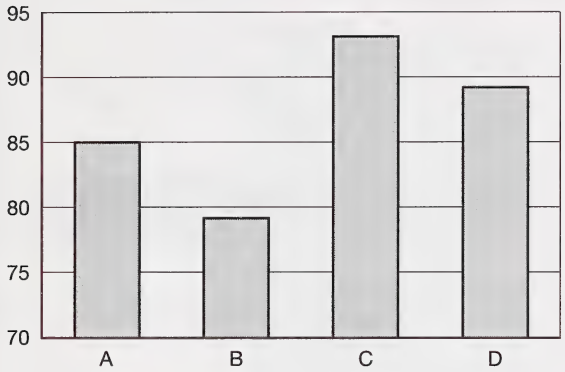
Your work in "Investigation 1: Looking at Graphs" should have convinced you that graphs can be used to mislead. Graphs can give a visual impression that leads you away from what the facts are telling you.

You saw how a graph could exaggerate differences. You also saw that the area a part of a graph takes up can give an impression that is different from the facts.

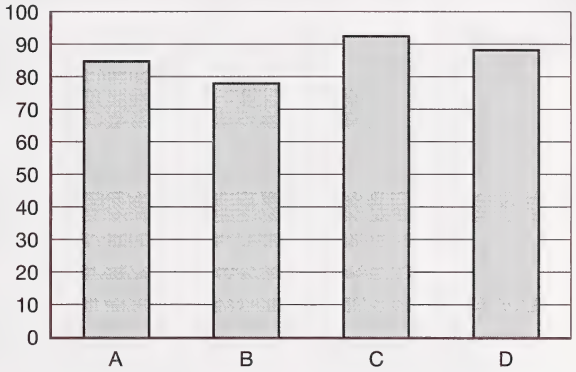
Example

Which of the following graphs is least likely to mislead someone?

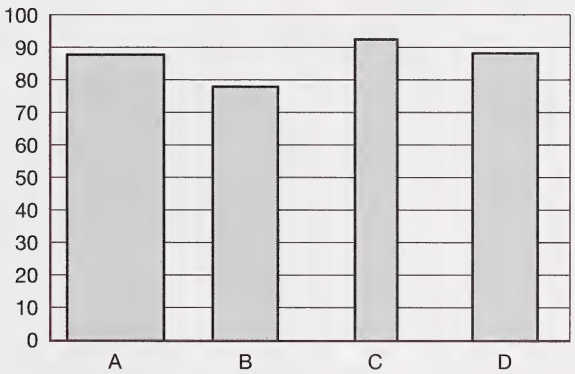
Graph A



Graph B



Graph C



The *y*-axis for Graph A starts at 70, so it exaggerates the differences in the values shown by the bars.

Graph C has different widths of bars, so it makes bar A seem larger than bar C when there is actually little difference.

Graph B uses neither trick.

Do you think words can be misleading?
The next investigation will help you decide.

2. Turn to page 233 in your textbook. Complete questions 1 and 4 of "Investigation 2: What's in a Headline?"

3. Turn to pages 234 to 236 in your textbook. Complete questions 1 to 5 of "Put into Practice."

Check your answers on pages 67 to 69 in the Appendix.

Turn to the Section 2 Assignment in Assignment Booklet 4A. Answer question 3.

CONCLUSION

In this section you studied how to graph data both by hand and by using a spreadsheet program. You studied how to read graphs to find information. You saw that crafty people can prepare graphs to mislead you. You also saw how easy it is to find trends in data when it is displayed graphically.

Maps contain a lot of data—you just need to know how to interpret that data. Luckily, unlike graphs, maps usually aren't used to misinform or mislead. If they were, your day trip into the back country could become an adventure you'd rather forget!

SECTION 3

Probability

Travelling in the winter can be full of surprises. It is possible to plan a trip, only to wake up and find your car and the roads covered in a foot of snow. Weather forecasts can be wrong. A storm that is expected to give just a light dusting of snow can fool the forecaster and dump a foot or more over everything.

Weather forecasts and websites often show something called POP, which stands for probability of precipitation. The weather forecaster on the radio or TV may say there is little chance of snow, while the website may say POP = 20%. They are both telling you that there is some doubt about whether snow will actually fall.

In this section you will look at the mathematical meaning of probability. Probability is looked at as both a theoretical concept and an experimental concept. You will also use probabilities to solve problems.

If you have access to the Internet and would like to know more about weather forecasts, visit the following website:

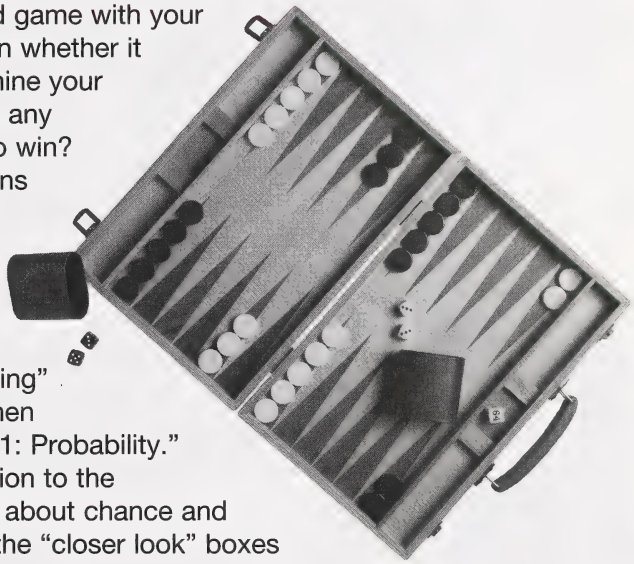
http://www.theweathernetwork.com/

LESSON 1

Theoretical Probability

In this lesson you will learn about chance, or how likely it is that a given event will occur.

Have you ever played a board game with your friends? Did you ever question whether it was fair to roll a die to determine your moves? Did using a die make any particular player more likely to win? You will be looking at questions like these as you learn about theoretical probability in this lesson.



Turn to page 237 in your textbook. Read the "get thinking" box at the top of the page. Then continue on to "Investigation 1: Probability." Here you will get an introduction to the mathematical way of thinking about chance and probability. Be sure to study the "closer look" boxes on page 238 carefully.

1. Turn to pages 237 and 238 in your textbook. Complete question 1 of "Investigation 1: Probability."

Check your answers on pages 69 and 70 in the Appendix.

The "closer look" boxes on page 238 showed you three different ways to use the word *probability* (belief, statistical, and theoretical). In "Investigation 2: **Theoretical Probability**," you will learn some of the important words used in probability (such as **experiment**, **outcome**, and **equally likely**.)

2. Turn to page 239 in your textbook. Complete questions 1 to 5 of "Investigation 2: Theoretical Probability."

Check your answers on page 70 in the Appendix.

In "Investigation 2" you saw the use of the notation ***P*(2)** to represent the probability of rolling a 2 on a die. This short-hand notation can save quite a lot of writing—you only need to write "*P*(2)," as opposed to writing "the probability of rolling a 2."

Turn to page 240 in your textbook and work through Example 1. Now that the ideas of experiments and outcomes are clearer, it's time to work with them.

Example

You are playing a board game with a friend. You are using a six-sided die. You need to roll a 4 to win. What is the probability that you will win on your roll of the die?

$$P(4) = \frac{\text{outcomes with a 4}}{\text{number of outcomes}}$$

$$= \frac{1}{6} \text{ or about } 0.1667$$

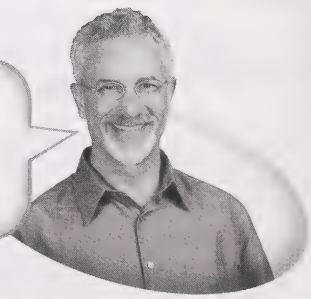
The probability of you winning on your roll of the die is about 0.1667.

3. Turn to page 241 in your textbook. Complete questions 1 to 3 of "Investigation 3: Rolling a Dodecahedron Die."

Check your answers on page 71 in the Appendix.

Continue on page 241 by studying the "closer look" box in the middle of the page. If something cannot happen, it has a probability of 0. If something has to happen, it has a probability of 1. Also notice that the terms *impossible outcome* and *certain outcome* are used to describe these situations.

Read through Example 2 on page 241. It gives more insight into impossible and certain outcomes. Then continue by turning to page 242 in your textbook and working through Example 3.



Understanding randomness is quite simple. You never know for sure what is going to turn up next. But, over a large number of trials, everything shows up about the same number of times. Try each of the following segments from the multimedia CD:

- "Getting Random Results: Coin"
- "Getting Random Results: Dice"
- "Getting Random Results: Spinner"

Use the highest number of trials for each type of random result. While the segments are running, watch how the results develop. Does there appear to be a pattern to the results as they happen? If you run one segment a few times, are the final results the same or different? Do the values come up the same way each time?

Hopefully you have seen that random events don't have a fixed pattern. Any possible outcome can happen next and it doesn't depend on what has happened before.

Example

You are again playing a board game with a friend. This time you are using a 12-sided die. If you roll a 4, you will lose. If you roll any other number, you will win. What is the probability you will win?

$$P(4) = \frac{\text{outcomes with a 4}}{\text{number of outcomes}}$$

$$= \frac{1}{12} \text{ or about } 0.0833$$

The probability of you losing on your roll of the die is $\frac{1}{12}$. That leaves $1-\frac{1}{12}=\frac{11}{12}$ (or about 0.9167) as the probability you will win.

You could also calculate the probability as follows:

$$P(1 \text{ or } 2 \text{ or } 3 \text{ or } 5 \text{ or } 6 \text{ or } 7 \text{ or } 8 \text{ or } 9 \text{ or } 10 \text{ or } 11 \text{ or } 12)$$

$$= P(1)+P(2)+P(3)+P(5)+P(6)+P(7)+P(8)+P(9)+P(10)+P(11)+P(12)$$

$$= \frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}$$

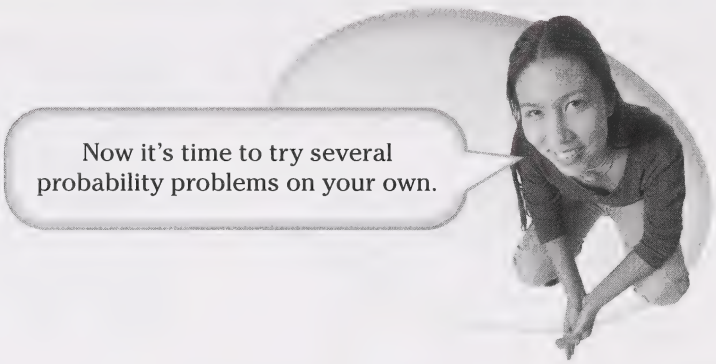
$$= \frac{11}{12}$$

Again the probability of winning is $\frac{11}{12}$.

Turn to page 243 in your textbook and read the introduction to "Investigation 4: Applying Probability."

4. Continue on page 243 in your textbook. Complete questions 1 to 6 of "Investigation 4: Applying Probability."

Check your answers on pages 71 and 72 in the Appendix.



5. Turn to pages 244 to 246 in your textbook. Complete the following questions:

- question 1 on page 244
- question 2.b. on page 245
- questions 3.b., 3.c., and 3.d. on page 245
- questions 4.a., 4.c., and 4.d. on page 245
- questions 5.c., 5.d., 5.e., and 5.f. on page 246
- questions 6.c., 6.d., 6.e., and 6.f. on page 246

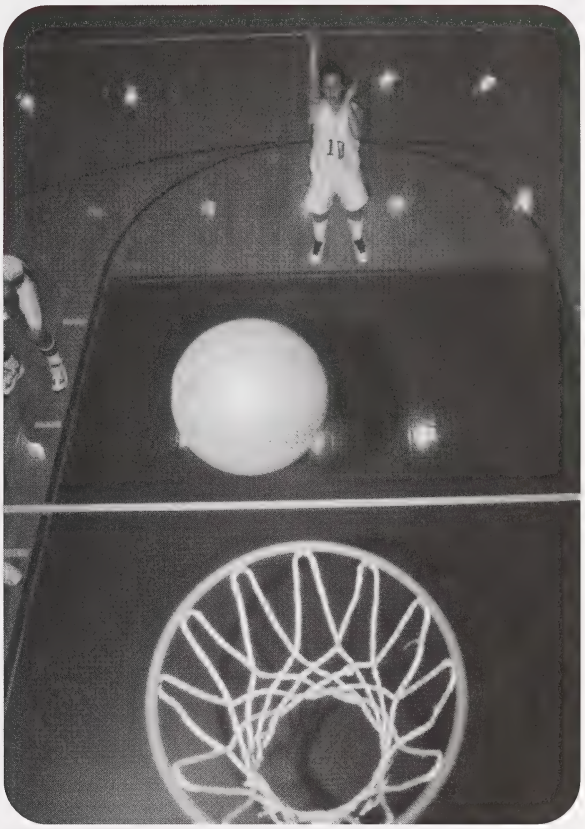
Check your answers on pages 72 to 76 in the Appendix.

Turn to the Section 3 Assignment in Assignment Booklet 4B. Answer question 1.

LESSON 2

Experimental Probability

In this lesson you will look at probabilities calculated from experiments. This is a more statistical way of considering probability.



When a player moves up to the foul line in a basketball game, his record on foul shots is known. The league will have statistics that tell how many foul shots he has taken and how many he has made.

Some people might say that the probability of him making this shot is $\frac{\text{foul shots made}}{\text{foul shots taken}}$. They know about this player's past performance and are using it to predict his future performance. They are using experimental probability.

Turn to page 247 in your textbook and read the "get thinking" box at the top of the page. Continue on page 247 by reading the introduction to "Tutorial Seven: Experimental Probability." It gives several examples of how **experimental probability** can be used.

1. Turn to page 248 in your textbook. Complete questions 1 and 2 of "Investigation 1: Experiments." If you don't have a class to share data with, use the data in the following tables to answer question 2.

Ten Trials of Tossing a Coin 20 Times										
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
Toss 1	T	H	H	T	H	H	T	H	T	H
Toss 2	T	T	H	T	T	H	H	T	T	H
Toss 3	T	H	H	T	H	H	T	T	H	T
Toss 4	T	H	H	T	H	H	H	H	T	H
Toss 5	T	H	H	T	H	H	T	H	T	T
Toss 6	H	T	H	H	H	T	H	T	T	H
Toss 7	H	T	H	T	T	T	T	T	T	T
Toss 8	T	T	H	H	T	T	H	T	T	T
Toss 9	T	H	H	T	T	H	T	T	H	T
Toss 10	H	H	T	T	H	T	T	T	H	H
Toss 11	H	H	T	H	T	H	H	T	T	T
Toss 12	H	H	H	T	H	T	H	H	T	H
Toss 13	H	T	T	H	T	H	H	T	H	H
Toss 14	T	T	H	T	H	H	H	H	T	T
Toss 15	H	T	T	H	T	H	H	H	T	H
Toss 16	H	T	T	H	H	H	H	H	T	H
Toss 17	H	T	T	T	H	T	H	T	H	T
Toss 18	H	T	T	T	H	T	H	T	H	H
Toss 19	H	H	T	T	T	H	H	H	H	T
Toss 20	T	H	H	T	T	T	T	T	T	T
Count of Heads	11	10	12	6	11	12	13	8	7	10

Ten More Trials of Tossing a Coin 20 Times										
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
Toss 1	T	H	T	H	T	H	T	T	T	H
Toss 2	H	T	T	T	T	T	H	H	T	H
Toss 3	H	H	H	H	H	T	T	T	H	T
Toss 4	H	H	H	T	T	H	T	H	T	T
Toss 5	T	H	T	T	T	H	H	H	T	T
Toss 6	T	H	T	H	H	H	H	H	H	H
Toss 7	T	T	H	H	T	H	T	T	T	T
Toss 8	H	H	T	H	T	H	H	H	T	H
Toss 9	T	H	H	T	H	H	T	H	H	H
Toss 10	H	H	H	H	H	T	H	H	T	H
Toss 11	T	T	T	H	T	H	H	T	T	H
Toss 12	T	H	T	T	T	H	H	T	H	T
Toss 13	H	T	H	H	T	T	T	H	H	T
Toss 14	T	H	H	T	H	H	H	T	T	H
Toss 15	T	H	T	H	H	H	H	H	T	T
Toss 16	T	T	T	T	H	T	T	H	T	T
Toss 17	H	H	T	H	H	H	H	T	T	H
Toss 18	H	H	H	T	T	T	T	T	T	T
Toss 19	T	H	T	H	T	T	H	T	H	H
Toss 20	H	T	T	T	H	H	H	T	H	T
Count of Heads	9	14	8	11	9	13	12	10	7	10

Check your answers on pages 76 and 77 in the Appendix.

Turn to page 249 in your textbook and work through the example. Then turn to page 251 in your textbook and read the introduction to "Investigation 2: Planning a Trip."

2. Continue on page 251 and answer questions 1 to 6 of "Investigation 2: Planning a Trip."

Check your answers on pages 77 and 78 in the Appendix.

Trial	Die 1	Die 2	Total
1			
2			
3			
4			
5			
6			
7			

This analysis in "Investigation 2: Planning a Trip" was based on theoretical probability. The next investigation lets you see how closely theoretical probability matches real-world (experimental) probability.

Turn to page 252 in your textbook and read the introduction to "Investigation 3: Theoretical versus Experimental Probability." You may find a table like the one to the left useful for recording your data.

Example

You have been given a grey four-sided die and a red eight-sided die. You wonder what the probability of rolling a sum of 10 is.

Start by building a table that shows all of the possible sums.

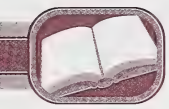
	1	2	3	4
1	1 + 1 = 2	1 + 2 = 3	1 + 3 = 4	1 + 4 = 5
2	2 + 1 = 3	2 + 2 = 4	2 + 3 = 5	2 + 4 = 6
3	3 + 1 = 4	3 + 2 = 5	3 + 3 = 6	3 + 4 = 7
4	4 + 1 = 5	4 + 2 = 6	4 + 3 = 7	4 + 4 = 8
5	5 + 1 = 6	5 + 2 = 7	5 + 3 = 8	5 + 4 = 9
6	6 + 1 = 7	6 + 2 = 8	6 + 3 = 9	6 + 4 = 10
7	7 + 1 = 8	7 + 2 = 9	7 + 3 = 10	7 + 4 = 11
8	8 + 1 = 9	8 + 2 = 10	8 + 3 = 11	8 + 4 = 12

From the table, you can see that there are $4 \times 8 = 32$ possible outcomes. You can also see that only three of these outcomes give a sum of 10.

$$P(10) = \frac{\text{outcomes with a sum of 10}}{\text{number of outcomes}}$$

$$= \frac{3}{32} \text{ or } 0.093\ 75$$

The probability of rolling a sum of 10 is $\frac{3}{32}$ or 0.093 75.



3. Continue on page 253 in your textbook by completing questions 2 to 9 of "Investigation 3: Theoretical versus Experimental Probability." If you don't have a class to share data with, use the following data for question 7.

20 Trials of Tossing 36 Pairs of Dice

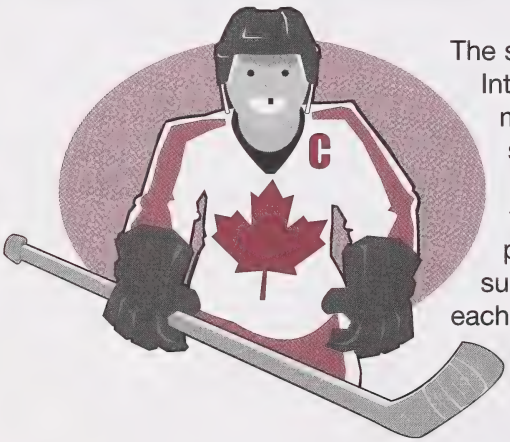
Sum of	2	3	4	5	6	7	8	9	10	11	12
Trial 1	2	3	4	2	5	6	6	3	3	2	0
Trial 2	0	1	4	1	9	3	7	6	2	2	1
Trial 3	1	2	2	5	1	11	4	5	2	2	1
Trial 4	3	3	2	4	4	7	3	4	3	3	0
Trial 5	1	3	1	2	10	5	2	6	3	3	0
Trial 6	1	0	3	2	6	10	7	3	1	3	0
Trial 7	0	1	5	3	5	8	2	3	6	2	1
Trial 8	0	1	1	1	3	9	9	6	4	1	1
Trial 9	1	4	2	6	9	3	3	2	4	2	0
Trial 10	2	3	6	2	3	2	7	8	2	1	0
Trial 11	2	2	3	4	1	3	6	6	7	2	0
Trial 12	2	3	4	2	3	7	5	2	5	2	1
Trial 13	0	1	4	4	5	4	6	5	5	1	1
Trial 14	0	3	4	2	6	7	7	2	3	1	1

Trial 13	0	1	4	4	5	4	6	5	5	1	1
Trial 14	0	3	4	2	6	7	7	2	3	1	1
Trial 15	1	3	1	5	1	6	9	7	1	0	2
Trial 16	2	2	3	3	4	5	2	4	6	3	2
Trial 17	1	2	1	6	5	5	9	6	0	1	0
Trial 18	0	1	4	3	2	8	7	5	2	2	2
Trial 19	0	4	3	4	5	4	3	4	4	5	0
Trial 20	3	3	3	3	4	9	4	3	2	1	1

Check your answers on pages 79 to 82 in the Appendix.

4. Turn to pages 255 and 256 in your textbook. Do questions 1.a., 1.b., 1.d., 1.f., 1.h., 1.j., 2, 3.a., 3.b., and 3.c. of "Put into Practice."

Check your answers on pages 83 and 84 in the Appendix.



The segment "Scoring Goals in an International Hockey Shootout," on the multimedia CD, gives you a chance to see probability in action. Try this as a competition between you and a friend. Try different combinations of probabilities for a team. (To be fair, the sums of the probabilities of scoring for each team should be the same.)

Do you score more goals with one very high probability and four very low probabilities, or with five evenly matched probabilities?

Enjoy your shootouts!

Turn to the Section 3 Assignment in Assignment Booklet 4B. Answer question 2.

CONCLUSION

In this section you learned about experimental and theoretical probability. You saw how these two concepts are similar and yet different. You used probability to solve problems and you conducted experiments to find experimental probability.

Do you now understand why weather forecasters are wrong sometimes? They can only give you the probability of an event (like a snow storm) occurring. It's just like the probability of a die turning up an even number—sometimes it just doesn't happen the way you expected.

The nice thing for travellers is that winter snowstorms do eventually end and the streets and roads get cleared. If you've been waiting for a big trip, the sight of a snowplow is very welcome.

MODULE SUMMARY

In this module you worked with maps, time, interpretation of data, and probability.

In Section 1 you studied how to use map scales to find the distances between places on a map. You also studied the concept of time zones and how to know what time it is in other places.

In Section 2 you studied how to use graphs and tables to interpret data. You learned how to use graphs to make predictions. You used both interpolation and extrapolation. You also saw how graphs can be manipulated to mislead.

In Section 3 you studied theoretical and experimental probability.

The young woman in the photo is consulting her map and checking her compass. She is taking part in an orienteering competition and is trying to figure out the best route to the next control point. It's a lot like reading a road map to find the town you're headed for, except she doesn't have a road or a path to follow—she has to decide her path for herself.

If this kind of competition appeals to you, you might want to find out more at **http://www.orienteering.ca/**.

Turn to Assignment Booklet 4B and complete the Final Module Assignment.

REVIEW

This Review will help you apply what you learned in Module 4 and prepare for the Final Test. Read the skills checklist for this module. Use this list to guide your study and to help you decide how much of the Review you should complete.

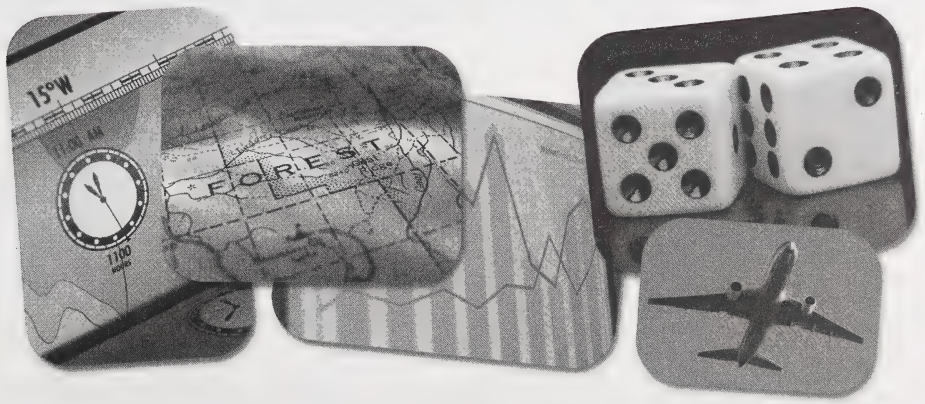
Skills Checklist

- ❑ Demonstrate an understanding of scale on a map.
- ❑ Use the scale on a map to find distances.
- ❑ Demonstrate an understanding of the 24-hour clock.
- ❑ Demonstrate an understanding of the time zones in Canada.
- ❑ Read and construct graphs.
- ❑ Find trends in data using lines of best fit.
- ❑ Make predictions from data using interpolation and extrapolation.
- ❑ Demonstrate an understanding of graphs that fairly represent data.
- ❑ Demonstrate an understanding of headlines that fairly represent data.
- ❑ Demonstrate an understanding of theoretical probability.
- ❑ Demonstrate an understanding of experimental probability.

Review Questions

Turn to pages 257 to 269 in your textbook. Answer "Review of Unit Four" questions 1, 3, 5, 6, 8, 10.a., 10.d., 10.f., 10.h., 10.j., 11.a., 11.c., 11.e., and 11.g.

Check your answers on pages 84 to 90 in the Appendix.



MATHEMATICS 24

Appendix

GLOSSARY
ANSWER KEY
IMAGE CREDITS

Glossary

24-hour time: a method of telling time that is used where mistaking morning for afternoon could have disastrous results (for example, in the military and transportation)

a.m.: a way of showing that the time is before noon, coming from the Latin *ante meridiem*, meaning "before midday"

bar graph: a graph with horizontal or vertical bars that represent data

circle graph: a graph where a circle represents the whole and the parts represent the data

daylight-saving time: a system where clocks are moved ahead one hour through the summer to give longer sunlit evenings

experiment: a collection of event data

experimental probability: a probability calculated by using the results of actual outcomes

equally likely: having the same likelihood of happening

extrapolate: to estimate values that are outside the range of given data

interpolate: to estimate values that are between given data points

line graph: a graph with line segments joining points that represent data (also called a broken-line graph)

line of best fit: a straight line that best shows the distribution of points in a scatter plot

outcome: the result of an experiment in probability

p.m.: a way of showing that the time is after noon, coming from the Latin *post meridiem*, meaning "after midday"

pie chart: See **circle graph**.

probability: the study of the likelihood of something happening

proportion: an equation showing that two ratios are equal

ratio: a comparison of two quantities with the same units

scale: a notation that shows how the size of a drawing compares to the real object

theoretical probability: a probability calculated using

$$P = \frac{\text{number of desired outcomes}}{\text{number of possible outcomes}}$$

time zone: an area that shares the same time (for example, the mountain time zone that includes Alberta, or the Atlantic time zone that includes Nova Scotia)

trend: a tendency found in data

trendline: a line that shows a trend on a graph

Answer Key

Section 1: Maps and Time

Lesson 1: Distances on a Map

1. Textbook, pages 198 and 199, "Investigation 1: How can you determine distance on a map using a simple scale?", questions 1 to 3

1. One way is to measure the border on the map and then measure the scale shown on the map. Then set up a proportion that lets you solve for the length of the border.

2. a. and **b.** The entire scale measures 2.4 cm. This corresponds to 300 + 900 = 1200 km. You could also measure from 0 to 900 on the scale, which is 1.8 cm, as stated in the textbook.

c. The border measures 2.5 cm on the map.

d. and **e.** A proportion is a way of comparing ratios. Set up the proportion so that it is easy to solve.

You know three things about the sizes on the map:

- You know that the Alberta-Saskatchewan border measures 2.5 cm.
- You know that the scale measures 1.8 cm.
- You know the real distance represented by the scale is 900 km.

You need to find a fourth size, the actual length of the border. Choose x to represent the real length of the border. A proportion that uses these facts can be set up in several ways, but the textbook says to set up two ratios. Each ratio is the actual distance compared to the measured distance.

$$\frac{\text{actual distance}}{\text{measured distance}}$$

There are two sets of data like this. There is the scale distance of 900 km and its measured distance of 1.8 cm. There is also the length of the border, x, and its measured distance, 2.5 cm.

Now write the proportion and solve it.

$$\frac{900\text{ km}}{1.8\text{ cm}} = \frac{x}{2.5\text{ cm}}$$

$$2.5\ \cancel{\text{cm}} \times \frac{900\text{ km}}{1.8\ \cancel{\text{cm}}} = \cancel{2.5\ \text{cm}} \times \frac{x}{\cancel{2.5\ \text{cm}}}$$

$$2.5 \times \frac{900\text{ km}}{1.8} = x$$

$$x = 2.5 \times \frac{500\ \cancel{900}\text{ km}}{\cancel{1.8}}$$

$$x = 2.5 \times 500\text{ km}$$

$$x = 1250\text{ km}$$

3. a. The actual length of the border is 1203 km.
b. The answers are quite close.

2. Textbook, pages 200 and 201, "Investigation 2: How can you determine distance using a ratio scale?", questions 1.a. to 1.f.

1. a. The scale 1:40 000 000 means that the actual distance is 40 million times larger than the distance on the map.

b. 40 000 000 cm is 400 000 m, which is 400 km.

$$40\,000\,000\text{ cm} = \cancel{40\,000\,000\ \text{cm}} \times \frac{1\text{ m}}{\cancel{100\ \text{cm}}}$$

$$= \cancel{400\,000\ \text{m}} \times \frac{1\text{ km}}{\cancel{1000\ \text{m}}}$$

$$= 400\text{ km}$$

c. 1 cm:400 km

The value for *b* is 400.

d. The distance from A to B on the map is 10.8 cm.

e. To find the actual distance from point A to point B, set up two ratios. Each ratio should compare the actual distance to the map distance.

$$\frac{\text{actual distance}}{\text{measured distance}}$$

One ratio is 400 km:1 cm. If you let *x* represent the actual distance from point A to point B, another ratio is *x*:10.8 cm.

The two ratios represent the same comparison, so you can write and solve a proportion.

$$\frac{400\text{ km}}{1\text{ cm}} = \frac{x}{10.8\text{ cm}}$$

$$10.8\ \cancel{\text{cm}} \times \frac{400\text{ km}}{1\ \cancel{\text{cm}}} = \cancel{10.8\ \text{cm}} \times \frac{x}{\cancel{10.8\ \text{cm}}}$$

$$10.8 \times \frac{400\text{ km}}{1} = x$$

$$x = 10.8 \times 400\text{ km}$$

$$x = 4320\text{ km}$$

The distance is 4300 km, correct to the nearest 100 km.

f. Is your answer the same as the one given?

3. Textbook, pages 201 to 203, "Put into Practice," questions 2.b., 4.a., 6.a., 7.b., and 8.b.

2. b. This border is curved. You have to move your ruler to follow it. The length you get should be larger than the straight-line distance.

The measured distance is 4.3 cm. Let x represent the actual distance. This gives the ratio x:4.3 cm. From Map 1, you know an equivalent ratio is 900 km:1.8 cm. Using these gives a proportion that can be solved to find the actual distance.

$$\frac{900\text{ km}}{1.8\text{ cm}} = \frac{x}{4.3\text{ cm}}$$

$$4.3\ \cancel{\text{cm}} \times \frac{900\text{ km}}{1.8\ \cancel{\text{cm}}} = \cancel{4.3\ \text{cm}} \times \frac{x}{\cancel{4.3\ \text{cm}}}$$

$$4.3 \times \frac{900\text{ km}}{1.8} = x$$

$$x = 4.3 \times \frac{\overset{500}{\cancel{900}}\text{ km}}{\cancel{1.8}}$$

$$x = 4.3 \times 500\text{ km}$$

$$x = 2150\text{ km}$$

The approximate length of the Canada–U.S.A. border from Vancouver to the Manitoba–Ontario border is 2150 km.

4. a. The southernmost point on the Canada–U.S.A. border is near Windsor, Ontario. The measured distance on the map from there to the northern tip of Ellesmere Island is 11.4 cm.

Let x represent the actual distance between these two places. This gives the ratio x:11.4 cm. From Map 2, you know another equivalent ratio is 400 km:1 cm. Using these gives a proportion that can be solved for the actual distance.

$$\frac{400 \text{ km}}{1 \text{ cm}} = \frac{x}{11.4 \text{ cm}}$$

$$11.4 \text{ cm} \times \frac{400 \text{ km}}{1 \text{ cm}} = 11.4 \text{ cm} \times \frac{x}{11.4 \text{ cm}}$$

$$11.4 \times \frac{400 \text{ km}}{1} = x$$

$$x = 11.4 \times 400 \text{ km}$$

$$x = 4560 \text{ km}$$

The distance from the northernmost part of Canada to the southernmost part of Canada is about 4560 km.

6. a. The distance table shows that distance from Lethbridge to Red Deer is about 300 km. You go down the left column until you reach Lethbridge. You go across the table in the Lethbridge row until you are under the Red Deer column. The value you find, 300, is the distance between Lethbridge and Red Deer.

7. b. i. The distance table shows the following distances:

- Calgary to Edmonton 290 km
- Edmonton to Vancouver 1160 km
- Vancouver to Calgary 980 km

The total distance is 290 + 1160 + 980 = 2430 km.

ii. The distance table shows the following distances:

- Montreal to Ottawa 205 km
- Ottawa to Toronto 400 km
- Toronto to Montreal 540 km

The total distance is 205 + 400 + 540 = 1145 km.

iii. The distance table shows the following distances:

- Vancouver to Toronto 4380 km
- Toronto to Montreal 540 km
- Montreal to Ottawa 205 km
- Ottawa to Vancouver 4460 km

The total distance is 4380 + 540 + 205 + 4460 = 9585 km.

8. b. The distance table shows the following distances:

- Edmonton to Vancouver 1160 km
- Vancouver to Regina 1720 km
- Regina to Winnipeg 570 km
- Winnipeg to Edmonton 1310 km

The total distance is 1160 + 1720 + 570 + 1310 = 4760 km.

Lesson 2: Time

1. Textbook, pages 204 and 205, "Investigation 1: 12 and 24 Hour Time," questions 1 to 4

1. This is one problem that occurs because there are two times in the day with the same number attached to them. You may have thought of other similar difficulties.

2. a. 2:00 p.m. becomes 14:00 h since 2 + 12 = 14.

b. 3:30 p.m. becomes 15:30 h since 3 + 12 = 15.

c. 11:00 p.m. becomes 23:00 h since 11 + 12 = 23.

d. 11:59 p.m. becomes 23:59 h since 11 + 12 = 23.

e. 11:00 a.m. becomes 11:00 h. For hours before noon, change the a.m. designation to "h" when changing to the 24-hour clock, and put a 0 in front if it is before 10:00 h.

3. a. 16:00 h becomes 4:00 p.m. since 16 – 12 = 4.

b. 18:30 h becomes 6:30 p.m. since 18 – 12 = 6.

c. 03:45 h becomes 3:45 a.m. Since the hour is less than 12, the "h" is replaced with a.m.

d. 13:01 h becomes 1:01 p.m. since 13 – 12 = 1.

4. Eastern parts of Canada are about 50° west of the international meridian (the prime meridian). Western parts of Canada are about 140° west of the international meridian. This is a span of about 90°. 90 ÷ 15 = 6, so Canada is large enough to have six time zones.

2. Textbook, pages 206 and 207, "Investigation 2: Time Zones," questions 1 to 5

1. a. There are two ways to look at this question, one where the zones that Alberta and Quebec are in are excluded, and one where they are included.

If you don't include the time zones that Alberta and Quebec are in, there is one time zone between Alberta and Quebec. It is the central standard time zone.

If you do include the time zones that Alberta and Quebec are in, there are three time zones between Alberta and Quebec—mountain standard time zone, central standard time zone, and eastern standard time zone.

b. The clock moves ahead as you move from Alberta to Quebec. (This makes sense because the sun rises in the east and their day starts sooner.)

c. When it is 4:00 a.m. in Alberta on Christmas Day, it is 6:00 a.m. in Montreal. There are two time zone changes. Each change to the east moves the clock ahead by one hour.

d. When it is 4:00 a.m. in Alberta on Christmas Day, it is 3:00 a.m. in Vancouver. There is one time zone change. One time zone change to the west moves the clock back one hour.

e. When it is 4:00 a.m. in Alberta on Christmas Day, it is 7:00 a.m. in Halifax. There are three time zone changes. Each change to the east moves the clock ahead by one hour.

2. If it is 7:00 a.m. in Edmonton, it is 10:30 a.m. in St. John's. There are four time zone changes. Three of them move the clock ahead one hour. The change to Newfoundland standard time requires only a half-hour change.

3. In the winter (from the last Sunday in October to the first Sunday in April), all provinces are on standard time.

a. 13:00 h in Regina on Valentine's Day is 11:00 h in Victoria. The time on the clock goes backward one hour for each time zone change going west. There are two time zone changes between Regina and Victoria.

b. 13:00 h in Regina on Valentine's Day is 15:00 h in St. John. (St. John is in New Brunswick. St. John's is in Newfoundland.) The time on the clock goes ahead one hour for each time zone change going east. There are two time zone changes between Regina and St. John.

c. 13:00 h in Regina on Valentine's Day is 13:00 h in Winnipeg. Regina and Winnipeg are in the same time zone.

d. 13:00 h in Regina on Valentine's Day is 12:00 h in Spirit River. The time on the clock goes backward one hour for each time zone change going west. There is one time zone change between Regina and Spirit River.

4. In the summer (like on Canada Day), only Saskatchewan is on standard time. You make the same calculations as in question 3, but adjust for the fact that the clock is already one hour ahead in the other provinces.

a. 13:00 h in Regina on Canada Day is 12:00 h in Victoria. The time on the clock goes backward one hour for each time zone change going west. There are two time zone changes between Regina and Victoria. This would suggest 11:00 h, but because of daylight-saving time moving the clock ahead one hour, it becomes 12:00 h.

b. 13:00 h in Regina on Canada Day is 16:00 h in St. John. The time on the clock goes ahead one hour for each time zone change going east. There are two time zone changes between Regina and St. John. This would suggest 15:00 h, but because of daylight-saving time moving the clock ahead one hour, it becomes 16:00 h.

c. 13:00 h in Regina on Canada Day is 14:00 h in Winnipeg. Regina and Winnipeg are in the same time zone. This would suggest that the time in Winnepeg would be 13:00 h, but adjusting for daylight-saving time gives 14:00 h.

d. 13:00 h in Regina on Canada Day is 13:00 h in Spirit River. The time on the clock goes backward one hour for each time zone change going west. There is one time zone change between Regina and Spirit River. This would suggest that the time in Spirit River would be 12:00 h, but adjusting for daylight-saving time gives 13:00 h.

5. a. 10:00 h in Barrie, Ontario, is 08:00 h in Medicine Hat. The time on the clock goes back one hour for each time zone change going west. There are two time zone changes between Medicine Hat and Barrie.

b. 11:30 h in Kelowna is 12:30 h in Medicine Hat. The time on the clock goes ahead one hour for each time zone change going east. There is one time zone change between Kelowna and Medicine Hat.

c. 15:00 h in St. John's is 11:30 h in Medicine Hat. The time on the clock goes back one hour for each time zone change going west, unless you start in the Newfoundland standard time zone. There are four time zone changes between St. John's and Medicine Hat. One of these is a half-hour change (from Newfoundland standard time to Atlantic standard time). The other three time zone changes are one-hour changes.

3. Textbook, page 208, "Put into Practice," questions 1 to 5

1. **a.** 6:00 p.m. in Edmonton is 8:00 p.m. in Montreal (two time zones east).
   b. 6:00 p.m. in Edmonton is 9:00 p.m. in Halifax (three time zones east).
   c. 6:00 p.m. in Edmonton is 5:00 p.m. in Vancouver (one time zone west).

2. **a.** 10:30 a.m. in Winnipeg is 8:30 a.m. in Victoria (two time zones west).

   b. 10:30 a.m. in Winnipeg is 11:30 a.m. in Hamilton (one time zone east).

   c. 10:30 a.m. in Winnipeg is 9:30 a.m. in Yellowknife (one time zone west).

   d. 10:30 a.m. in Winnipeg is 13:00 in St. John's (two regular time zones east plus the special Atlantic standard time–Newfoundland standard time zone change).

3. **a.** 10:30 a.m. in Winnipeg is 13:00 in Newfoundland (two regular time zones east plus the special Atlantic standard time–Newfoundland standard time zone change).

   b. 10:30 a.m. in Winnipeg is 9:30 a.m. in Saskatchewan. (There are no time zone changes, but Winnipeg jumps one hour ahead in the summer.)

4. The plane leaves at 9:30 a.m. If passengers did not change their watches, they would read 09:30 h + 4:30 = 14:00 h. They need to set their watches back three hours because they passed westward through three time zones. After this change, their watches would say 11:00 h. They would have arrived in Vancouver at 11:00 a.m. local time.

5. **a.** 07:30 h in Toronto is 05:30 h in Calgary (two time zones west).
   b. 07:30 h in Toronto is 08:30 h in Halifax (one time zone east).

Section 2: Data

Lesson 1: Reading, Displaying, and Interpreting Statistics

1. Textbook, pages 209 and 210, "Investigation: Displaying Data," questions 1 and 2.a.

1. **a.** The bar graph tells how many games were won by each team in the American League Eastern Division.

   b. The NY Yankees had the most wins.

   c. Baltimore had the fewest wins.

   d. The total number of wins is 4 + 10 + 11 + 6 + 6 = 37.

2. a. Answers will vary. A sample answer follows.

I preferred the pictograph. It was visually more interesting. It made it clear that the graph dealt with baseball. The values were easier to find.

2. Textbook, pages 216 to 219, "Put into Practice," questions 1, 3, 4, 5, 8.a., 8.b., and 8.c.

1. a. The years 1983 and 1988 are being compared.
b. Chemical weeding showed the greatest increase. It increased by 80 000 hectares.
c. Thinning showed no noticeable change. About 58 000 hectares were treated this way.

3. a. White spruce was the most commonly planted tree.

b. Jack pine amounts to $\frac{13}{100}$ of the trees planted.

4. a. i. The value in 1965 was $40 billion.
ii. The value in 1975 was $70 billion.
iii. The value in 1980 was $85 billion.
iv. The value in 1985 was $95 billion.

b. The trend shown is an increase in the value of services provided.

c. The footnote tells you that changes in the value of the dollar are not the reason the graph is rising.

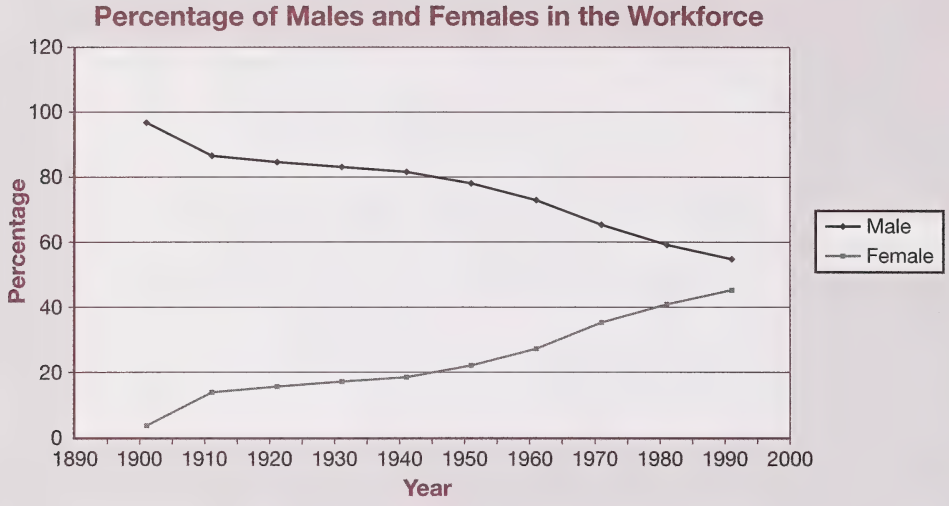
5. a. The graph shows the composition of the workforce during the twentieth century.

b. The male percentage of the workforce has declined. The female percentage of the workforce has increased.

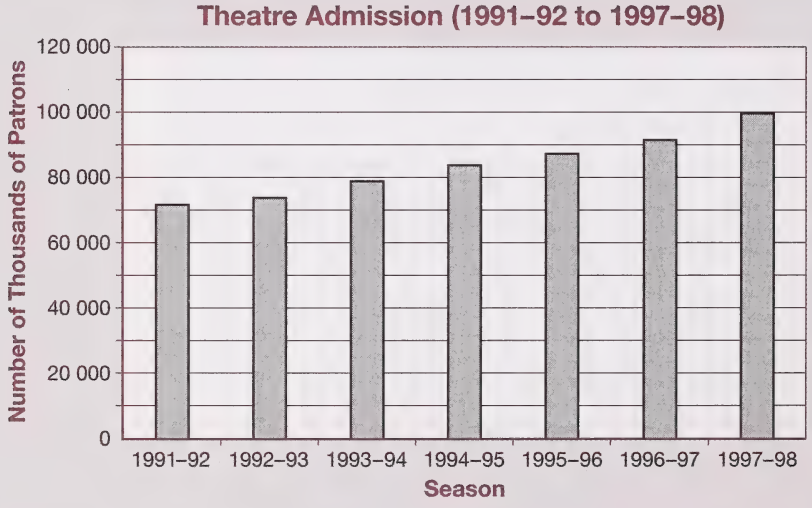
c. In 1981, 40.7% of the workforce was female. In 1921, 15.5% of the workforce was female. This is an increase of 25.2%.

d. In 1901, 96.7% of the workforce was male. In 1991, 54.7% of the workforce was male. This is a decline of 42%.

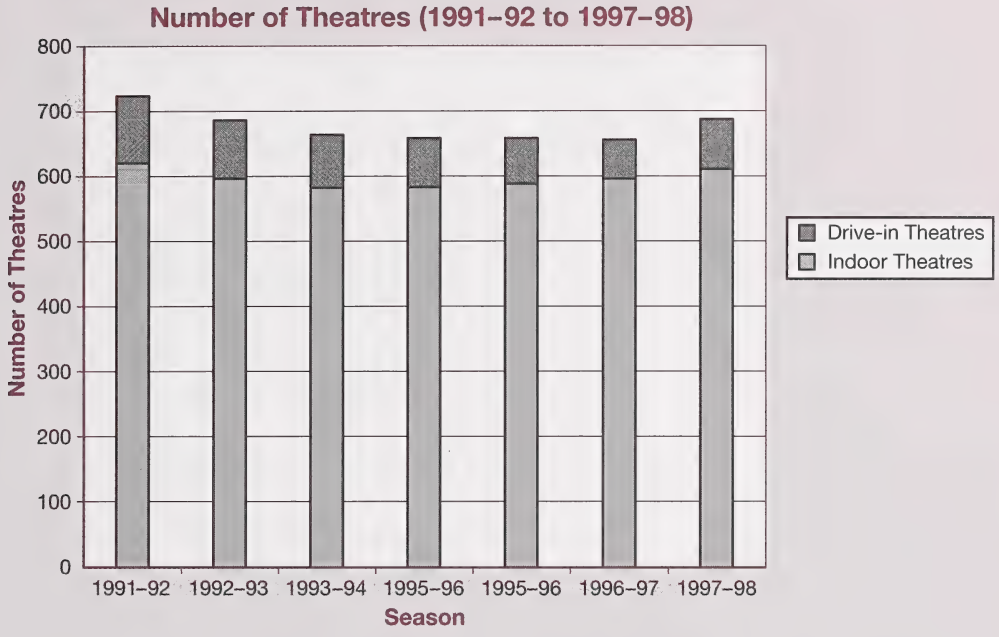
e. Following is a double-line graph that shows the same information.



8. a. The following graph shows admissions over the years. You may have drawn a different kind of graph.



b. The following graph shows the number of theatres over the years.



c. Theatre admissions are going up. The number of theatres declined and then began increasing. The number of drive-in theatres is declining.

Lesson 2: Trends and Predictions

Textbook, pages 226 to 229, "Put into Practice," questions 1 to 5

1. a. There is a general upward trend. The dots on the graph get higher from left to right (except for the 1990 dot).

b. i. 1965 is not listed on the graph. It is halfway between 1960 and 1970. A reasonable estimate would be a value halfway between the ones for 1960 and 1970. 1960 is about \$300 000 000 and 1970 is about \$500 000 000, so the approximate value for 1965 would be \$400 000 000, which is halfway between these values.

$$\frac{\$300\,000\,000 + \$500\,000\,000}{2} = \$400\,000\,000$$

ii. 1975 is not listed on the graph. It is halfway between 1970 and 1980. A reasonable estimate would be a value halfway between the ones for 1970 and 1980. 1970 is about \$400 000 000 and 1980 is about \$6 000 000 000, so an approximate value for 1975 would be \$3 200 000 000, which is halfway between these values.

$$\frac{\$400\,000\,000 + \$6\,000\,000\,000}{2} = \$3\,200\,000\,000$$

iii. 1995 is not listed on the graph. It is halfway between 1990 and 2000. A reasonable estimate would be a value halfway between the ones for 1990 and 2000. 1990 is about \$5 400 000 000 and 2000 is about \$13 600 000 000, so an approximate value for 1995 would be \$9 500 000 000, which is halfway between these values.

$$\frac{\$5\,400\,000\,000 + \$13\,600\,000\,000}{2} = \$9\,500\,000\,000$$

c. The values you found were between known values, so the process used was interpolation.

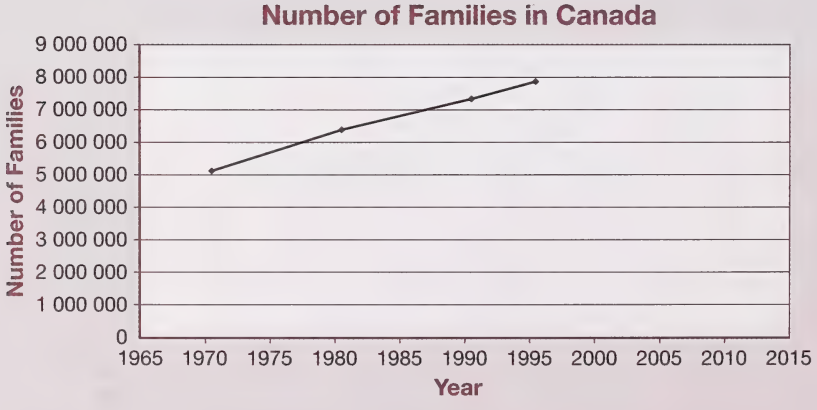
2. a. The trend seems to be upward, but it is starting to level off.

b. i. 2000 is not on the graph. You have to extend the graph in your mind to include this year. A reasonable estimate would be about \$2 002 000 000 for the year 2000.

ii. 2001 is not on the graph. You have to extend the graph in your mind to include this year. A reasonable estimate would be about \$2 003 000 000 for the year 2001.

c. The values you found were beyond the known values, so the process used was extrapolation.

3. a. A scatter plot would be an appropriate graph. Since you will be interpolating values from the graph, joining the points with a line will be helpful. A sample graph follows.



b. **i.** 1976 is halfway between 1971 and 1981. The value on the graph is about 5 800 000.

ii. 1989 is between 1981 and 1991, but closer to 1991. The value on the graph is about 7 100 000.

iii. 1995 is between 1991 and 1996, but closer to 1996. The value on the graph is about 7 700 000.

c. **i.** 2000 is beyond the last data point. The extended trend line gives an estimate of 8 300 000 families.

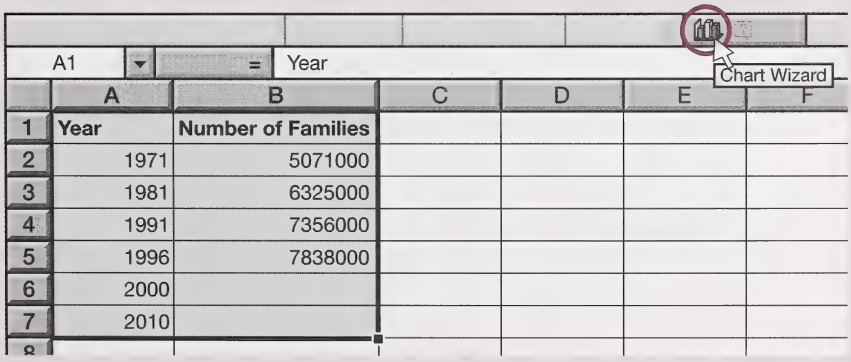
ii. 2010 is farther beyond the last data point. The extended trend line gives an estimate of 9 450 000 families.

Adding a trendline to the graph will let you estimate values for the future. Following are instructions for how to get a trendline using Microsoft Excel:

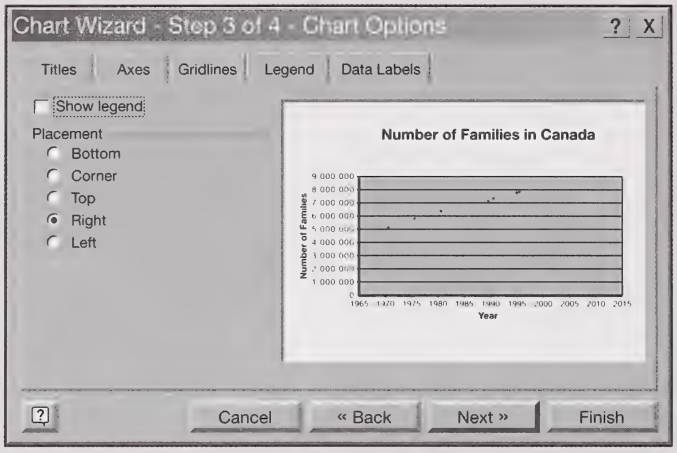
- Start by entering the data into columns A and B. Include the years that you want to extrapolate to.

	A	B
1	**Year**	**Number of Families**
2	1971	5071000
3	1981	6325000
4	1991	7356000
5	1996	7838000
6	2000	
7	2010	

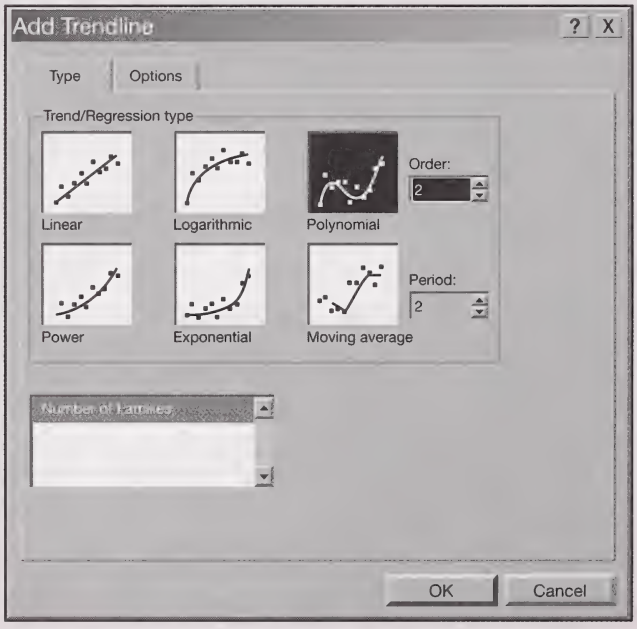
- Select the data you have entered and then click on the Chart Wizard button.



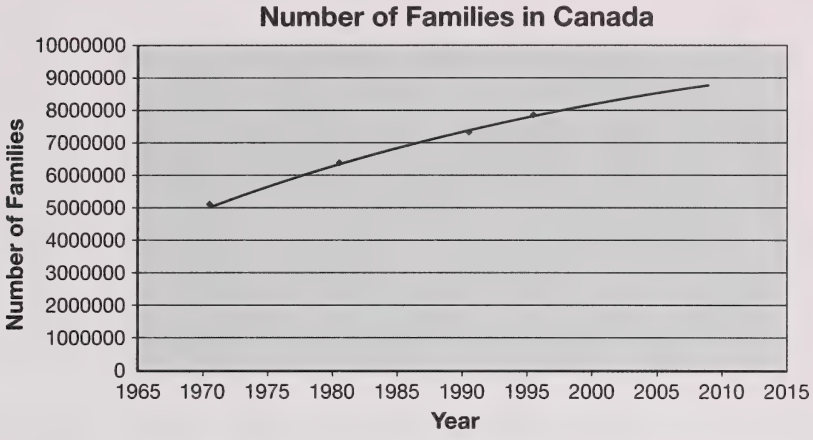
- Choose XY (Scatter) and then click the Next button twice. Add the titles under the Titles tab and remove the legend under the Legend tab. Then click the Next button followed by the Finish button.



- Right click on one of the data points on the chart and choose Add Trendline. Choose the Polynomial type of Order 2 and then click on the OK button.

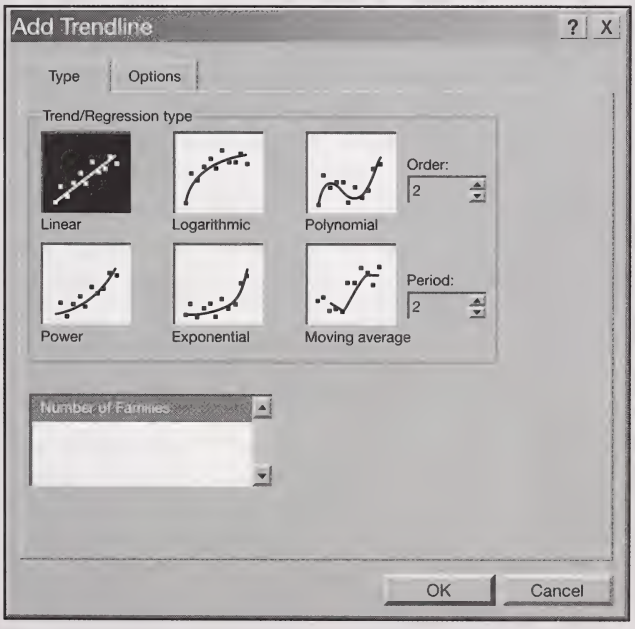


- Your graph will now have a trendline much like the one here.

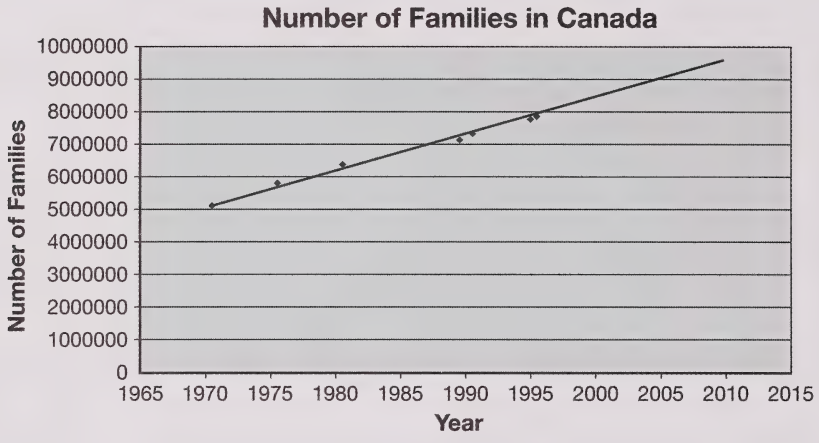


- If you click on a trendline and press the Delete key, the line will be erased. Do this to this trendline.

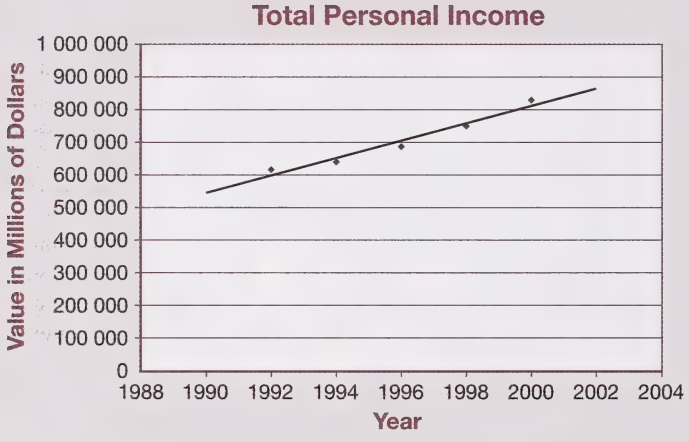
- Right click on one of the data points on the chart and choose Add Trendline. Choose the Linear type and then click on the OK button.

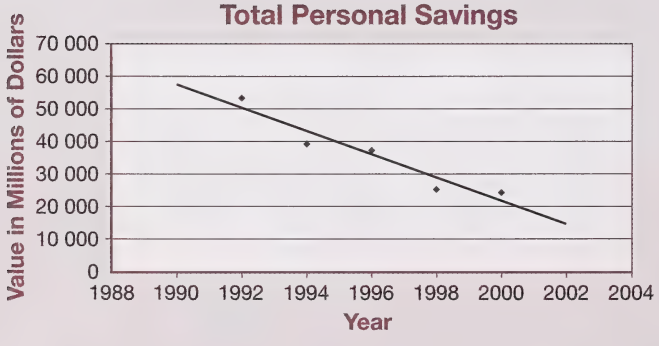


You will get a graph much like this one. You should try other types of trendlines to see which one you think shows the trend best.



4. a. Answers will vary. Sample graphs and lines of best fit follow.





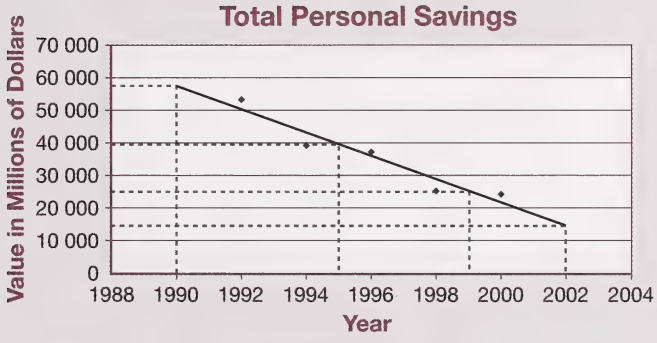
b. The broken lines on the graphs that follow show how to make the estimates. Go up from the year until you hit the line of best fit. Go straight over to the vertical axis to get an approximate value.

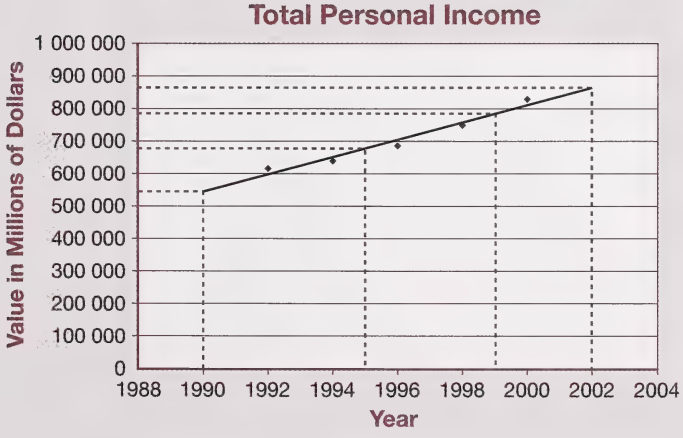
i. An estimate for 1990 income is $545 000 000 000.
An estimate for 1990 savings is $57 500 000 000.

ii. An estimate for 1995 income is $675 000 000 000.
An estimate for 1995 savings is $39 500 000 000.

iii. An estimate for 1999 income is $780 000 000 000.
An estimate for 1999 savings is $25 000 000 000.

iv. An estimate for 2002 income is $865 000 000 000.
An estimate for 2002 savings is $14 500 000 000.



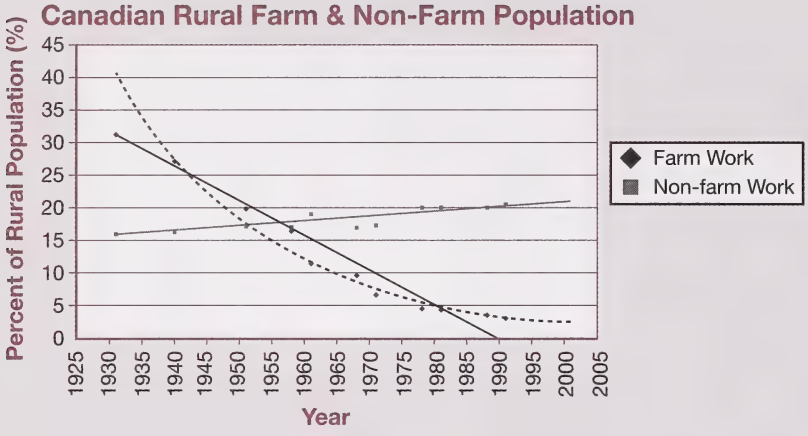


c. Answers will vary. A sample answer follows.

There are more people working and the average wage is rising. This would explain the increasing trend of total personal income. People want to enjoy their lives, so they spend their money on the things they want. This would explain why savings are decreasing.

5. a. Answers will vary. A sample graph follows.

Two types of trendlines were made for farm work since the line of best fit seems to vary too much from the real data. The dotted curve is exponential and the solid dark line is the line of best fit.



b. The estimates for the farm work category are made using the dotted exponential trendline.

i. Estimates for 1946 are 21.5% for farm and 17% for non-farm.
ii. Estimates for 1967 are 9% for farm and 18.5% for non-farm.
iii. Estimates for 1989 are 4% for farm and 20% for non-farm.
iv. Estimates for 2001 are 2.5% for farm and 21% for non-farm.

c. i. The farm population seems to be decreasing. The non-farm population seems to be increasing.

ii. This occurred in about 1959. The two percentages were very close in 1958 and widely apart by 1961.

iii. The number of people that are needed to run farms is decreasing due to larger and better equipment and better methods and chemicals.

Lesson 3: Fair and Accurate Presentation of Data

1. Textbook, pages 230 to 232, "Investigation 1: Looking at Graphs," questions 1 and 2

1. a. Company B probably ran the ad. It makes their vehicles look better than the other companies' cars.

b. Company C would prefer the second graph. It makes it hard to see that Company C's vehicles are a little less likely to be roadworthy after five years.

2. a. The chartered banks have 80% of students' banking business; other institutions have 20% of the business. The ratio is 80%:20% or 4:1.

b. These rectangles are shown in the textbook.

c. The small rectangle is 0.7 cm by 0.7 cm. The large rectangle is 2.4 cm by 2.8 cm.

d. The area of the rectangles is calculated as follows.

Small Rectangle	**Large Rectangle**
$A = bh$	$A = bh$
$= 0.7 \text{ cm} \times 0.7 \text{ cm}$	$= 2.4 \text{ cm} \times 2.8 \text{ cm}$
$= 0.49 \text{ cm}^2$	$= 6.72 \text{ cm}^2$

e. The large rectangle has an area of 6.72 cm^2, while the small rectangle has an area of 0.49 cm^2. This is a ratio of 6.72:0.49, or about 13.7:1.

f. The ratio of the areas is much larger than the ratio of the percents. This is not a fair graph. The impression you get from the graph is that the banks' share of business is much larger than it really is.

2. Textbook, page 233, "Investigation 2: What's in a Headline?" questions 1 and 4

1. and **4.** Answers will vary. They will depend on the data that is collected.

3. Textbook, pages 234 to 236, "Put into Practice," questions 1 to 5

1. It is unclear what the statement "25% More Fruit" means. It might mean 25% more fruit than in the jam sold last year. It might mean 25% more fruit than in a similar product. It might mean 25% more fruit than the recipe called for.

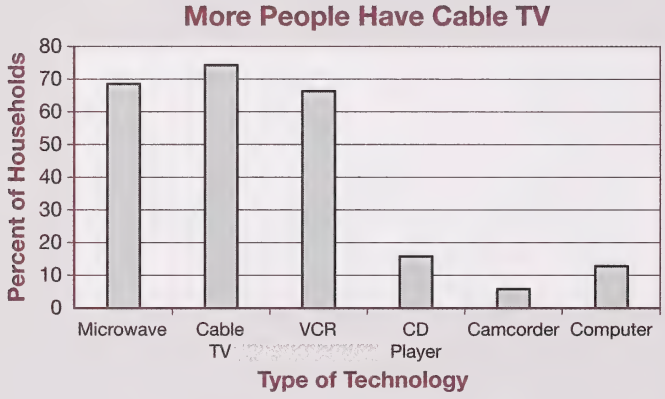
2. It is not clear what the statement means. Does it mean 3 out of 4 people paid to try it? Does it mean that 3 out of 4 people who buy it keep buying it? Does it mean that a scientific survey was carried out and this is the result?

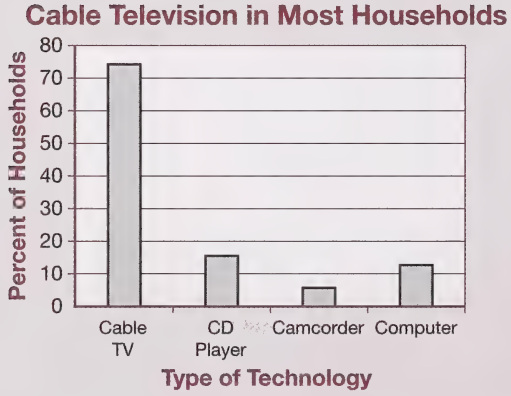
3. **a.** You have to consider the following:

   - how many students take part in each sport
   - what is considered an injury
   - how the injuries were recorded
   - the number of student hours spent on each sport

   b. It is not fair to conclude that basketball is the most dangerous sport. It would depend on how many students played each sport, how many hours were spent playing each sport, and on the severity of the injuries that occurred.

4. **a.** You could use a creative label or you could leave out other products. You may have used a different kind of graph.

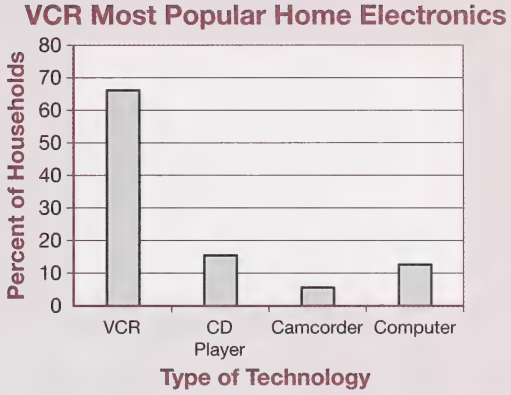




The second graph gives the impression that cable TV is the most popular type of electronic product for the home.

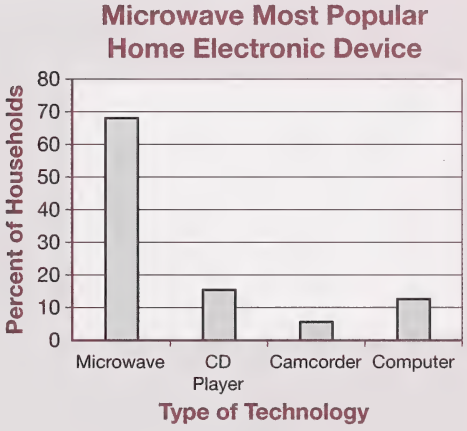
b. You could leave out other products.

This graph gives the impression that VCRs are the most popular type of electronic product for the home.



c. You could leave out other products.

This graph gives the impression that microwaves are the most popular type of electronic product for the home.



5. a. Since fewer 12 to 17 year olds listen to country music than older people, it would be best to use the 18 and over figures.

b. A contemporary radio station owner would want to use the 12 to 17 age group since this kind of music is very popular with this age group.

Section 3: Probability

Lesson 1: Theoretical Probability

1. Textbook, pages 237 and 238, "Investigation 1: Probability," question 1

1. Answers will vary. Sample answers follow

a. It is **probable** that the sun will rise tomorrow morning.
The sun will **probably** rise tomorrow morning.
The **probability** of the sun rising tomorrow morning is very high.

The sentences all convey the idea that there is little doubt about the sun rising tomorrow morning.

b. **i.** Probability is used to show that there is little chance of failure.

ii. Probability is used to explain that babies are slightly more likely to be boys than girls.

iii. The chance of rolling a 2 with a single die is the same as the ratio of faces marked with 2 to the number of faces on the die.

c. **i.** The **probability** that my car will start tonight is 75%.

ii. The **probability** of rain on June 30 is 20%.

iii. The **probability** of a tossed coin landing heads is $\frac{1}{2} = 0.5$.

2. Textbook, page 239, "Investigation 2: Theoretical Probability," questions 1 to 5

1. The probability of getting a tail when you flip a coin is 50%.

2. **a.** All possible outcomes are 1, 2, 3, 4, 5, and 6.

b. The probability of rolling a 3 is $\frac{1}{6} \doteq 0.1667$. There is one 3 among the six possible outcomes.

c. **i.** The probability of rolling a 1 is $\frac{1}{6} \doteq 0.1667$. There is one 1 among the six possible outcomes.

ii. The probability of rolling a 4 is $\frac{1}{6} \doteq 0.1667$. There is one 4 among the six possible outcomes.

iii. The probability of rolling a 5 is $\frac{1}{6} \doteq 0.1667$. There is one 5 among the six possible outcomes.

iv. The probability of rolling a 6 is $\frac{1}{6} \doteq 0.1667$. There is one 6 among the six possible outcomes.

v. The probability of rolling a 2 is $\frac{1}{6} \doteq 0.1667$. There is one 2 among the six possible outcomes.

3. Answers will vary. A sample answer is given.

Put three marbles into an opaque bag. One marble is red, one marble is blue, and the third marble is yellow. Reach into the bag and pick a marble without looking. The probability of choosing the red marble is $\frac{\text{1 red marble}}{\text{3 marbles to choose from}} = \frac{1}{3}$. The probability of choosing the blue marble is also $\frac{1}{3}$. These are equally likely outcomes.

4. Since there are 12 faces and only one March in a year, the probability of March being face up is $\frac{\text{1 month of March}}{\text{12 months to choose from}} = \frac{1}{12}$, or about 0.0833.

5. The experiment described in the answer to question 3 would have three equally likely outcomes.

3. Textbook, page 241, "Investigation 3: Rolling a Dodecahedron Die," questions 1 to 3

1. The probability of rolling a 3 is $\frac{1}{12} \doteq 0.0833$.

$$\frac{\text{1 side labelled 3}}{\text{12 sides to choose from}} = \frac{1}{12}$$

2. a. There are six even numbers on the 12-faced die. They are 2, 4, 6, 8, 10, and 12.

b. The probability of rolling an even number is 0.5.

$$\frac{\text{6 sides labelled with even numbers}}{\text{12 sides to choose from}} = \frac{6}{12}$$
$$= \frac{1}{2}$$

3. a. The probability of rolling a particular number is about 0.0833.

$$\frac{\text{1 side labelled with the number}}{\text{12 sides to choose from}} = \frac{1}{12}$$

The probability of rolling any number is 1.

$$\frac{\text{12 sides with numbers}}{\text{12 sides to choose from}} = \frac{12}{12} \text{ or } 1$$

b. The probability of not rolling that number is about 0.9167.

$$\frac{\text{11 sides not labelled with the number}}{\text{12 sides to choose from}} = \frac{11}{12}$$

The probability of not rolling any number is 0.

$$\frac{\text{0 sides without a number}}{\text{12 sides to choose from}} = \frac{0}{12} \text{ or } 0$$

c. Are these the same values you found?

4. Textbook, page 243, "Investigation 4: Applying Probability," questions 1 to 6

1. The probability of the die turning up 5 is $\frac{1}{6}$, so the probability that Jasper is the first place visited is also $\frac{1}{6} \doteq 0.1667$.

2. The probability of the die turning up 4 is $\frac{1}{6}$, so the probability that Medicine Hat is the first place visited is also $\frac{1}{6} \doteq 0.1667$.

3. The probability that the die turns up 4 or 5 is

$$\frac{\text{1 side labelled 4 plus 1 side labelled 5}}{\text{6 sides to choose from}} = \frac{2}{6}$$

Therefore the probability that Medicine Hat or Jasper is the first place visited is $\frac{2}{6} = \frac{1}{3}$, or about 0.3333.

4. Since there are three locations, the probability is $\frac{3}{6} = \frac{1}{2}$, or 0.5.

5. **a.** The probability that no community is visited is 0. There are only six possible outcomes and all of them involve a community. This is an impossible outcome.

   b. The probability that one of the communities is visited is 1. There are six possible outcomes and one of them will occur. This is a certain outcome.

6. Since each of the friends has an equal chance of their location being chosen, it is a fair way of making a decision.

5. Textbook, pages 244 to 246, "Put into Practice," questions 1, 2.b., 3.b., 3.c., 3.d., 4.a., 4.c., 4.d., 5.c., 5.d., 5.e., 5.f., 6.c., 6.d., 6.e., and 6.f.

1. a. i. $P(\text{Calgary}) = \frac{2}{16} = \frac{1}{8}$ or 0.125

ii. $P(\text{Winnipeg}) = \frac{4}{16} = \frac{1}{4}$ or 0.25

iii. $P(\text{Vancouver}) = \frac{6}{16} = \frac{3}{8}$ or 0.375

iv. $P(\text{Edmonton}) = \frac{4}{16} = \frac{1}{4}$ or 0.25

v. $P(\text{Edmonton or Calgary}) = \frac{4+2}{16} = \frac{6}{16} = \frac{3}{8}$ or 0.375

vi. $P(\text{Winnipeg or Vancouver}) = \frac{4+6}{16} = \frac{10}{16} = \frac{5}{8}$ or 0.625

b. The probabilities are the same.

c. The sum of the probabilities of a.i. and a.iv. is $\frac{3}{8}$, or 0.375.

$$\begin{aligned}\frac{1}{8}+\frac{1}{4} &= \frac{1}{8}+\frac{2\times 1}{2\times 4}\\ &= \frac{1}{8}+\frac{2}{8}\\ &= \frac{3}{8}\end{aligned}$$

This answer and the answer from a.v. are the same. They both represent the probability of the tickets being for Calgary or Edmonton.

d. The sum of probabilities a.v. and a.vi. is 1.

$$\begin{aligned}\frac{3}{8}+\frac{5}{8} &= \frac{8}{8}\\ &= 1\end{aligned}$$

This is because either the city is in Alberta or it is not in Alberta. There are no other possibilities.

2. b. Remaining in the bag are 2 yellow cubes, 3 blue cubes, $7 - 2 = 5$ red cubes, and $8 - 3 = 5$ black cubes.

i. The probability of winning a chocolate bar is about 0.3333.

$$\begin{aligned}P(\text{black}) &= \frac{5}{2+3+5+5}\\ &= \frac{5}{15}\\ &= \frac{1}{3}\\ &\doteq 0.3333\end{aligned}$$

ii. The probability of winning a calculator is the probability of winning a graphing calculator or a regular calculator.

$$\begin{aligned}P(\text{red or yellow}) &= \frac{5+2}{2+3+5+5}\\ &= \frac{7}{15}\\ &\doteq 0.4667\end{aligned}$$

iii. The probability of winning a prize is 1. You will choose a cube and that means you will win a prize.

3. b. There are 13 hearts in a regular deck of 52 cards. The probability of drawing a heart is $\frac{1}{4} = 0.25$.

$$P(\text{heart}) = \frac{13}{52}$$
$$= \frac{1}{4} \text{ or } 0.25$$

c. There are three face cards in each of four suits. There are 12 face cards in all. The probability of drawing a face card is about 0.2308.

$$P(\text{face card}) = \frac{12}{52}$$
$$= \frac{3}{13}$$
$$\doteq 0.2308$$

d. There are 13 spades, so of the 52 cards, 52 –13 = 39 are not spades. The probability of drawing a non-spade card is $\frac{3}{4} = 0.75$.

$$P(\text{not spade}) = \frac{39}{52}$$
$$= \frac{3}{4} \text{ or } 0.75$$

4. There are a total of 10 + 8 + 12 + 7 + 5 + 4 + 4 = 50 chocolates in the box.

a. The nut centres are cashew, almond, and walnut.

$$P(\text{nut centre}) = P(\text{cashew or almond or walnut})$$
$$= \frac{10+8+12}{50}$$
$$= \frac{30}{50}$$
$$= \frac{3}{5} \text{ or } 0.6$$

c. There are $50 - 8 = 42$ centres that are not almond.

$$P(\text{not almond}) = \frac{42}{50}$$
$$= \frac{21}{25} \text{ or } 0.84$$

d. The fruit centres are cherry, raspberry, strawberry, and lemon.

$$P(\text{fruit centre}) = P(\text{cherry or raspberry or strawberry or lemon})$$
$$= \frac{7+5+4+4}{50}$$
$$= \frac{20}{50}$$
$$= \frac{2}{5} \text{ or } 0.4$$

5. There are a total of $8 + 5 + 4 + 3 = 20$ balls in the bag.

c. $P(\text{yellow}) = \frac{4}{20}$
$$= \frac{1}{5} \text{ or } 0.2$$

d. $P(\text{green}) = \frac{3}{20}$ or 0.15

e. Since all balls have a colour, this probability is 1.

f. $P(\text{not red}) = \frac{20-8}{20}$
$$= \frac{12}{20}$$
$$= \frac{3}{4} \text{ or } 0.75$$

6. c. There are four odd numbers on the spinner (3, 5, 7, and 9).

$$P(\text{odd}) = \frac{4}{7}$$

d. There are three prime numbers on the spinner (3, 5, and 7).

$$P(\text{prime}) = \frac{3}{7} \text{ or about } 0.4286$$

e. There are three multiples of 2 on the spinner (4, 6, and 8).

$$P(\text{multiples of } 2) = \frac{3}{7} \text{ or about } 0.4286$$

f. The number 10 is not on the spinner.

$$P(10) = \frac{0}{7}$$
$$= 0$$

Lesson 2: Experimental Probability

1. Textbook, page 248, "Investigation 1: Experiments," questions 1 and 2

1. a. The expected result would have been 5000 heads.

b. He actually got 5031 heads.

$$502 + 511 + 497 + 529 + 504 + 476 + 507 + 528 + 504 + 473 = 5031$$

c. His experiments suggest a probability of $\frac{5031}{10\,000}$ or 0.5031.

d. The difference is $5031 - 5000 = 31$.

e. The percentage difference is 0.62%

$$\frac{31}{5000} = \frac{x}{100}$$
$$\frac{31 \div 50}{5000 \div 50} = \frac{x}{100}$$
$$\frac{0.62}{100} = x$$
$$x = 0.62\%$$

2. a. Answers will vary.

b. Answers will vary. Sample data was given in the lesson.

c. Answers will vary. This answer uses the data given in the lesson.

There were a total of 203 heads out of 400 tosses. This gives an experimental probability of $\frac{203}{400}$ or 0.5075.

2. Textbook, page 251, "Investigation 2: Planning a Trip," questions 1 to 6

A completed chart for "Investigation 2: Planning a Trip" follows.

		Red Die					
		1	**2**	**3**	**4**	**5**	**6**
Green Die	**1**	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

1. There are four ways of rolling a 5 (1 + 4, 2 + 3, 3 + 2, and 4 + 1).

2. There are a total of 36 ways to roll a pair of dice.

3. The probability that Manitoba is the starting point for the trip is $\frac{1}{9}$.

$$P(\text{Manitoba}) = P(5)$$
$$= \frac{4}{36}$$
$$= \frac{1}{9} \text{ or about } 0.1111$$

4. $P(\text{British Columbia}) = P(2)$
$$= \frac{1}{36}$$
$$\doteq 0.0278$$

$P(\text{Alberta}) = P(3)$
$$= \frac{2}{36}$$
$$= \frac{1}{18}$$
$$\doteq 0.0556$$

$P(\text{Saskatchewan}) = P(4)$

$= \frac{3}{36}$

$= \frac{1}{12}$

$\doteq 0.0833$

$P(\text{Manitoba}) = P(5)$

$= \frac{4}{36}$

$= \frac{1}{9}$

$\doteq 0.1111$

$P(\text{Nunavut}) = P(6)$

$= \frac{5}{36}$

$\doteq 0.1389$

$P(\text{Ontario}) = P(7)$

$= \frac{6}{36}$

$= \frac{1}{6}$

$\doteq 0.1667$

$P(\text{Quebec}) = P(8)$

$= \frac{5}{36}$

$\doteq 0.1389$

$P(\text{New Brunswick}) = P(9)$

$= \frac{4}{36}$

$= \frac{1}{9}$

$\doteq 0.1111$

$P(\text{Nova Scotia}) = P(10)$

$= \frac{3}{36}$

$= \frac{1}{12}$

$\doteq 0.0833$

$P(\text{Prince Edward Island}) = P(11)$

$= \frac{2}{36}$

$= \frac{1}{18}$

$\doteq 0.0556$

$P(\text{Newfoundland and Labrador}) = P(12)$

$= \frac{1}{36}$

$\doteq 0.0278$

5. They are most likely to start in Ontario.

6. Answers will vary. A sample answer follows.

This method is not fair. Each place has a different chance of being chosen.

3. Textbook, page 253, "Investigation 3: Theoretical versus Experimental Probability," questions 2 to 9

2. assumed done

3. and **4.** Answers will vary. A sample table follows.

Trial	Red	Green	Total	Trial	Red	Green	Total
1	4	5	9	19	1	3	4
2	5	1	6	20	4	2	6
3	5	5	10	21	2	4	6
4	2	1	3	22	1	4	5
5	5	5	10	23	5	1	6
6	4	4	8	24	3	3	6
7	2	2	4	25	5	2	7
8	5	5	10	26	2	1	3
9	1	4	5	27	4	2	6
10	3	5	8	28	2	3	5
11	1	2	3	29	4	1	5
12	4	1	5	30	1	3	4
13	3	5	8	31	4	1	5
14	1	4	5	32	3	3	6
15	4	1	5	33	1	5	6
16	3	5	8	34	5	5	10
17	1	4	5	35	3	1	4
18	2	2	4	36	4	2	6

Sum	2	3	4	5	6	7	8	9	10	11	12
Number	0	3	5	9	9	1	4	1	4	0	0

5. The following experimental probabilities are for the sample tables provided for the answers for questions 3 and 4.

$$P(2) = \frac{0}{36} = 0 \qquad P(3) = \frac{3}{36} = \frac{1}{12} \doteq 0.0833 \qquad P(4) = \frac{5}{36} \doteq 0.1389 \qquad P(5) = \frac{9}{36} = \frac{1}{4} = 0.25$$

$$P(6) = \frac{9}{36} = \frac{1}{4} = 0.25 \qquad P(7) = \frac{1}{36} \doteq 0.0833 \qquad P(8) = \frac{4}{36} = \frac{1}{9} \doteq 0.1111 \qquad P(9) = \frac{1}{36} \doteq 0.0833$$

$$P(10) = \frac{4}{36} = \frac{1}{9} \doteq 0.1111 \qquad P(11) = P(12) = 0$$

6. Answers will vary. Sample answers are based on the previous values.

The experimental probability for a sum of 2 was less than the theoretical probability.
The experimental probability for a sum of 3 was more than the theoretical probability.
The experimental probability for a sum of 4 was more than the theoretical probability.
The experimental probability for a sum of 5 was more than the theoretical probability.
The experimental probability for a sum of 6 was more than the theoretical probability.
The experimental probability for a sum of 7 was less than the theoretical probability.
The experimental probability for a sum of 8 was less than the theoretical probability.
The experimental probability for a sum of 9 was less than the theoretical probability.
The experimental probability for a sum of 10 was more than the theoretical probability.
The experimental probability for a sum of 11 was less than the theoretical probability.
The experimental probability for a sum of 12 was less than the theoretical probability.

7. Answers will vary. A sample set of data was given in the lesson.

8. Answers will vary. A sample answer using the data given in the lesson follows.

Sum	2	3	4	5	6	7	8	9	10	11	12
Number	22	45	60	64	91	122	108	90	65	39	14

There are a total of 720 tosses of two die summarized in this chart.

The following experimental probabilities are for the values provided in the preceding table.

$$P(2) = \frac{22}{720} = \frac{11}{360} \doteq 0.0306 \qquad P(3) = \frac{45}{720} = \frac{1}{16} = 0.065$$

$$P(4) = \frac{60}{720} = \frac{1}{12} \doteq 0.0833 \qquad P(5) = \frac{64}{720} = \frac{4}{45} \doteq 0.0889$$

$$P(6) = \frac{91}{720} \doteq 0.1264 \qquad P(7) = \frac{122}{720} = \frac{61}{360} \doteq 0.1694$$

$$P(8) = \frac{108}{720} = \frac{3}{20} = 0.15 \qquad P(9) = \frac{90}{720} = \frac{1}{8} = 0.125$$

$$P(10) = \frac{65}{720} = \frac{13}{144} \doteq 0.0903 \qquad P(11) = \frac{39}{720} = \frac{13}{240} \doteq 0.0542$$

$$P(12) = \frac{14}{720} = \frac{7}{360} \doteq 0.0194$$

9. Answers will vary. A sample answer that is based on the previous values follows.

Notice that in the statements of probability that follow, the theoretical probability is represented by P_t and the experimental probability by P_e. It's a shorthand way to show the difference that saves a lot of writing.

- For a sum of 2, the experimental probability was more than the theoretical probability.

  $P_e(2) \doteq 0.0306$ $\qquad$ $P_t(2) = \frac{1}{36} \doteq 0.0278$

- For a sum of 3, the experimental probability was more than the theoretical probability.

  $P_e(3) = 0.065$ $\qquad$ $P_t(3) = \frac{1}{18} \doteq 0.0556$

- For a sum of 4, the experimental probability was the same as the theoretical probability.

  $P_t(4) = \frac{1}{12} \doteq 0.0833$ $\qquad$ $P_e(4) \doteq 0.0833$

- For a sum of 5, the theoretical probability was more than the experimental probability.

$$P_t(5) = \frac{1}{9} \doteq 0.1111 \qquad P_e(5) \doteq 0.0889$$

- For a sum of 6, the theoretical probability was more than the experimental probability.

$$P_t(6) = \frac{5}{36} \doteq 0.1389 \qquad P_e(6) \doteq 0.1264$$

- For a sum of 7, the experimental probability was more than the theoretical probability.

$$P_e(7) \doteq 0.1694 \qquad P_t(7) = \frac{1}{6} \doteq 0.1667$$

- For a sum of 8, the experimental probability was more than the theoretical probability.

$$P_e(8) = 0.15 \qquad P_t(8) = \frac{5}{36} \doteq 0.1389$$

- For a sum of 9, the experimental probability was more than the theoretical probability.

$$P_e(9) = 0.125 \qquad P_t(9) = \frac{1}{9} \doteq 0.1111$$

- For a sum of 10, the experimental probability was more than the theoretical probability.

$$P_e(10) \doteq 0.0903 \qquad P_t(10) = \frac{1}{12} \doteq 0.0833$$

- For a sum of 11, the theoretical probability was more than the experimental probability.

$$P_t(11) = \frac{1}{18} \doteq 0.0556 \qquad P_e(11) \doteq 0.0542$$

- For a sum of 12, the theoretical probability was more than the experimental probability.

$$P_t(12) = \frac{1}{36} \doteq 0.0278 \qquad P_e(12) \doteq 0.0194$$

4. Textbook, pages 255 and 256, "Put into Practice," questions 1.a., 1.b., 1.d., 1.f., 1.h., 1.j., 2., 3.a., 3.b., and 3.c.

1. a. $P(\text{African Origin in Alberta}) = \dfrac{7000}{2\,669\,195}$

$\doteq 0.002\,62$

b. $P(\text{Arab Origin in British Columbia}) = \dfrac{5545}{3\,689\,760}$

$\doteq 0.001\,50$

d. $P(\text{French Origin in Canada}) = \dfrac{2\,683\,840}{28\,528\,125}$

$\doteq 0.094\,08$

f. $P(\text{Aboriginal Origin in NWT}) = \dfrac{32\,755}{64\,125}$

$\doteq 0.510\,80$

h. $P(\text{Caribbean Origin in Canada}) = \dfrac{305\,290}{28\,528\,125}$

$\doteq 0.010\,70$

j. $P(\text{European Origin in Canada}) = \dfrac{3\,742\,895}{28\,528\,125}$

$\doteq 0.131\,20$

2. $P(\text{triplets in Canada}) = \dfrac{375}{4\,203\,000}$

$= \dfrac{1}{11\,208}$

$\doteq 0.000\,089\,22$

3. a. The quick brown fox jumps over a lazy dog.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
2	1	1	1	2	1	1	1	1	1	1	1	1	1	4	1	1	2	1	1	2	1	1	1	1	1

The sentence uses every letter of the alphabet.

b. The probability of choosing each letter from the given sentence is shown below the frequency for that letter.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
2	1	1	1	2	1	1	1	1	1	1	1	1	1	4	1	1	2	1	1	2	1	1	1	1	1
$\frac{2}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{2}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{4}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{2}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{2}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$	$\frac{1}{33}$

3. c. i. $P(\text{vowel}) = P(\text{a or e or i or o or u})$

$$= \frac{2+2+1+4+2}{33}$$

$$= \frac{11}{33}$$

$$= \frac{1}{3}$$

$$\doteq 0.3333$$

ii. $P(\text{consonant}) = P(\text{not vowel})$

$$= \frac{33-11}{33}$$

$$= \frac{22}{33}$$

$$= \frac{2}{3}$$

$$\doteq 0.6667$$

Review

Textbook, pages 257 to 269, "Review" questions 1, 3, 5, 6, 8, 10.a., 10.d., 10.f., 10.h., 10.j., 11.a., 11.c., 11.e., and 11.g.

1. a. To find the actual distance, you start by measuring the distance on the map. You then use the given scale in a proportion to find the actual distance. The proportion you use is $\frac{\text{actual distance}}{\text{measured distance}} = \frac{5\,000\,000}{1}$. You will have to change from the units you measure in (cm) to larger units (km) to make the actual distance more understandable.

b. i. The actual distance for 7 cm is 350 km.

$$\frac{\text{actual distance}}{\text{measured distance}} = \frac{5\,000\,000}{1}$$

$$\frac{\text{actual distance}}{7\text{ cm}} = \frac{5\,000\,000}{1}$$

$$\text{actual distance} = 7\text{ cm} \times 5\,000\,000$$

$$\text{actual distance} = 7\,\cancel{\text{cm}} \times 5\,000\,000 \times \frac{1\,\cancel{\text{m}}}{100\,\cancel{\text{cm}}} \times \frac{1\text{ km}}{1000\,\cancel{\text{m}}}$$

$$= \frac{35\,000\,000}{100\,000}\text{ km}$$

$$= 350\text{ km}$$

ii. The actual distance is 730 km.

$$\frac{\text{actual distance}}{\text{measured distance}} = \frac{5\,000\,000}{1}$$

$$\frac{\text{actual distance}}{14.6 \text{ cm}} = \frac{5\,000\,000}{1}$$

$$\text{actual distance} = 14.6 \text{ cm} \times 5\,000\,000$$

$$\text{actual distance} = 14.6 \cancel{\text{cm}} \times 5\,000\,000 \times \frac{1 \cancel{\text{m}}}{100 \cancel{\text{cm}}} \times \frac{1 \text{ km}}{1000 \cancel{\text{m}}}$$

$$= \frac{73\,000\,000}{100\,000} \text{ km}$$

$$= 730 \text{ km}$$

c. i. The map distance for 650 km is 13.0 cm.

$$\frac{\text{measured distance}}{\text{actual distance}} = \frac{1}{5\,000\,000}$$

$$\frac{\text{measured distance}}{650 \text{ km}} = \frac{1}{5\,000\,000}$$

$$\text{measured distance} = 650 \text{ km} \times \frac{1}{5\,000\,000}$$

$$\text{measured distance} = 650 \cancel{\text{km}} \times \frac{1}{5\,000\,000} \times \frac{1000 \cancel{\text{m}}}{1 \cancel{\text{km}}} \times \frac{100 \text{ cm}}{1 \cancel{\text{m}}}$$

$$= \frac{65\,000\,000}{5\,000\,000} \text{ cm}$$

$$= 13 \text{ cm}$$

ii. The map distance for 390 km is 7.8 cm.

$$\frac{\text{measured distance}}{\text{actual distance}} = \frac{1}{5\,000\,000}$$

$$\frac{\text{measured distance}}{390 \text{ km}} = \frac{1}{5\,000\,000}$$

$$\text{measured distance} = 390 \text{ km} \times \frac{1}{5\,000\,000}$$

$$\text{measured distance} = 390 \cancel{\text{km}} \times \frac{1}{5\,000\,000} \times \frac{1000 \cancel{\text{m}}}{1 \cancel{\text{km}}} \times \frac{100 \text{ cm}}{1 \cancel{\text{m}}}$$

$$= \frac{39\,000\,000}{5\,000\,000} \text{ cm}$$

$$= 7.8 \text{ cm}$$

iii. The map distance for 30 km is 0.6 cm.

$$\frac{\text{measured distance}}{\text{actual distance}} = \frac{1}{5\,000\,000}$$

$$\frac{\text{measured distance}}{30 \text{ km}} = \frac{1}{5\,000\,000}$$

$$\text{measured distance} = 30 \text{ km} \times \frac{1}{5\,000\,000}$$

$$\text{measured distance} = 30 \cancel{\text{km}} \times \frac{1}{5\,000\,000} \times \frac{1000 \cancel{\text{m}}}{1 \cancel{\text{km}}} \times \frac{100 \text{ cm}}{1 \cancel{\text{m}}}$$

$$= \frac{3\,000\,000}{5\,000\,000} \text{ cm}$$

$$= 0.6 \text{ cm}$$

3. a. This graph is about electrical generating capacity.

b. The thermal capacity reached 10 GW in about 1965. (Measure the height of the bar for thermal capacity in 1960 and compare that length with the scale. It is too short. Measure the height of the bar for thermal capacity in 1970 and compare that length with the scale. It is too long. 10 GW was reached somewhere between these two years.)

c. Nuclear power is first seen in substantial amounts in 1975.

d. There were about 60 GW of hydro-electric capacity in 1990. (Measure the length of the bar for hydro-electric capacity in 1990. Compare this length with the scale.)

e. In 1980 the capacities were about

- thermal 25 GW
- hydro-electric 55 GW
- nuclear 5 GW

5. a. The points are discrete, so a broken-line graph was used.

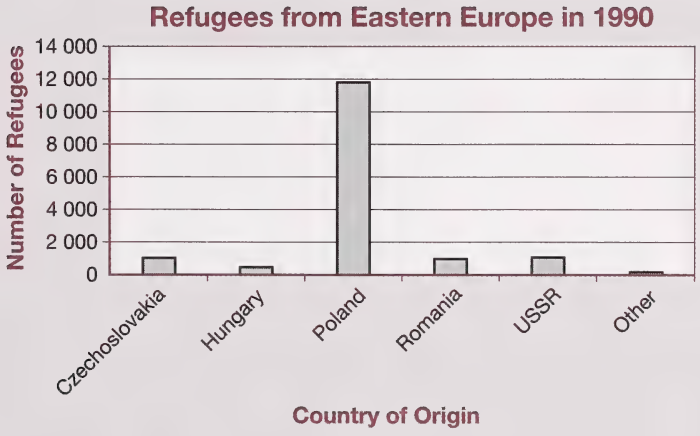
b. i. In 1990 about 3700 PJ were used.
ii. In 1995 about 5600 PJ were used.

c. i. 4400 PJ were used in 1992.
ii. 5850 PJ were used in 1997.

d. You would expect to find about 6100 PJ in supply in 2000.

6. a. You first have to find how many refugees came from Eastern European countries that are not given in the chart. This number is found as follows. From the total number of refugees from Eastern Europe, subtract the number from each given country.

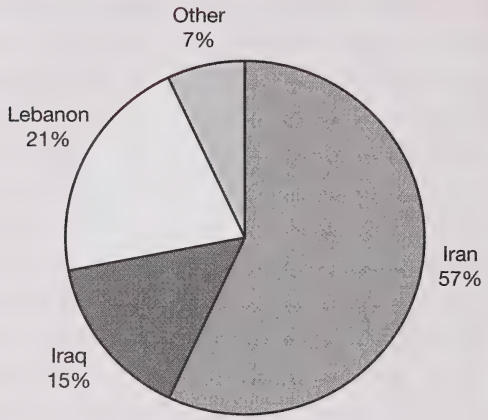
$$15\,831-(1149+500+11\,874+1015+1151)=15\,831-15\,689$$
$$=142$$



b. This also requires that you find the number of refugees from countries that are not listed on the given table. This number is found as follows.

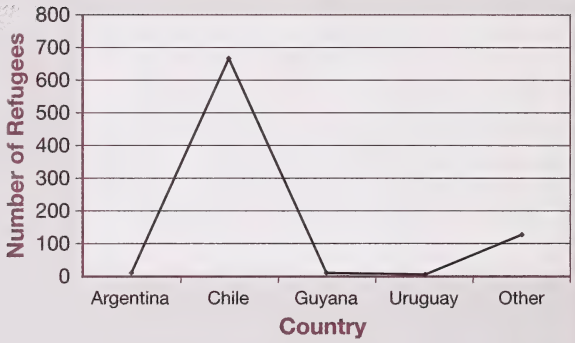
$$3515-(2013+514+725)=3515-3252$$
$$=263$$

Refugees from the Middle East in 1990



c. There is an "other" category needed. It has 129 people in it.

Refugees from South America



8. a. Totals for Canada, when rounded to the nearest 100, are as follows:

1980: 67 000 1995: 150 300
1985: 80 100 1999: 158 000
1990: 139 900 2000: 164 100

b. **i.** The resale value of Canadian homes for 1987 was about $110 400.
ii. The resale value of Canadian homes for 1994 was about $145 300.
iii. The resale value of Canadian homes for 2002 will probably be $178 700.

c. You should have used a trendline using the data from the chart. The results in part b. used a polynomial trendline of order 2.

10. a. The probability of getting an 8 is $\frac{5}{36} \doteq 0.14$.

d. The probability of getting a 5 or a 7 is about 0.28.

$$\begin{aligned}\frac{4}{36}+\frac{6}{36} &= \frac{10}{36}\\ &= \frac{5}{18}\\ &\doteq 0.28\end{aligned}$$

f. The probability of getting greater than 5 is the same as starting with everything and removing the probabilities of things you are not interested in.

$$\begin{aligned}1-\left(\frac{1}{9}+\frac{1}{12}+\frac{1}{18}+\frac{1}{36}\right) &= 1-\left(\frac{4+3+2+1}{36}\right)\\ &= 1-\frac{10}{36}\\ &= \frac{36-10}{36}\\ &= \frac{26}{36}\\ &\doteq 0.72\end{aligned}$$

You could also do it by adding all of the probabilities you are interested in.

$$\begin{aligned}\frac{1}{36}+\frac{1}{18}+\frac{1}{12}+\frac{1}{9}+\frac{5}{36}+\frac{1}{6}+\frac{5}{36} &= \frac{1+2+3+4+5+6+5}{36}\\ &= \frac{26}{36}\\ &\doteq 0.72\end{aligned}$$

h. The probability of getting 1 is 0. (The sum of two numbers each no less than 1 will always be greater than 1.)

j. The probability of an odd number is found by adding all the probabilities of odd number sums.

$$3 \quad 5 \quad 7 \quad 9 \quad 11$$

$$\frac{1}{18}+\frac{1}{9}+\frac{1}{6}+\frac{1}{9}+\frac{1}{18}=\frac{2+4+6+4+2}{36}$$

$$=\frac{18}{36}$$

$$=\frac{1}{2}$$

$$\doteq 0.50$$

11. a. $P(\text{high school education only in Canada})=\dfrac{3\ 238\ 590}{22\ 628\ 925}$

$$\doteq 0.14$$

$$\doteq 14\%$$

c. $P(\text{university degree in Canada})=\dfrac{5\ 197\ 665}{22\ 628\ 925}$

$$\doteq 0.23$$

$$\doteq 23\%$$

e. $P(\text{less than Grade 5 in Nova Scotia})=\dfrac{9\ 985}{719\ 975}$

$$\doteq 0.01$$

$$\doteq 1\%$$

g. $P(\text{high school education only in New Brunswick})=\dfrac{85\ 795}{585\ 025}$

$$\doteq 0.15$$

$$\doteq 15\%$$

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Multimedia

Following is a list of the multimedia segments for Module 4 that appear on the multimedia CD:

- "Getting Random Results: Coin"
- "Getting Random Results: Dice"
- "Getting Random Results: Spinner"
- "Scoring Goals in an International Hockey Shootout"

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